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ARBORETUM BULLETIN

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Concerning this issue. . .

We are pleased to have articles this time by two of the Northwest's outstanding horticulturists, B. LeRoy Davidson and J.D. Vertrees. Mr. Davidson lives in Seattle but is a world traveller, as his article indicates. He is also an exceptionally discriminating collector of plants. Mr. Vertrees is a leading expert on Japanese maples and has a nursery in Roseburg, Oregon — the Maplewood Nursery, which specializes in these beautiful trees.

The Tea House in the Japanese Garden is finally under construction. After completion of this long-awaited structure, tea ceremonies will be held there, and it will be used for instruction in the art of tea. The article relating the early history of the tea ceremony in Japan by Ruth Vorobik was written in conjunction with the training sessions she is organizing for Japanese Garden Guides this spring.

For those who are environmentally-oriented, Professor Bastiaan J.D. Meeuse has written a timely article explaining the role that plants can play as indicators of air pollution. For those who have a wanderlust, we begin a series on the Arboretum Tour of New Zealand, led by Joe Witt this fall. Those who are interested in the psychology of landscape will enjoy the article on landscape perception by Elizabeth Rivers.

We regret that Susyn Andrew's article on hollies in the Arboretum will not reach you in time for the holiday season, but this issue of the *Arboretum Bulletin* is late.

Kay Handsfield and I have enjoyed bringing you the *Bulletin* and we shall miss the challenges it has provided. We join the Editorial Board in welcoming your new editor, Chris Miller.

JAN PIRZIO-BIROLI

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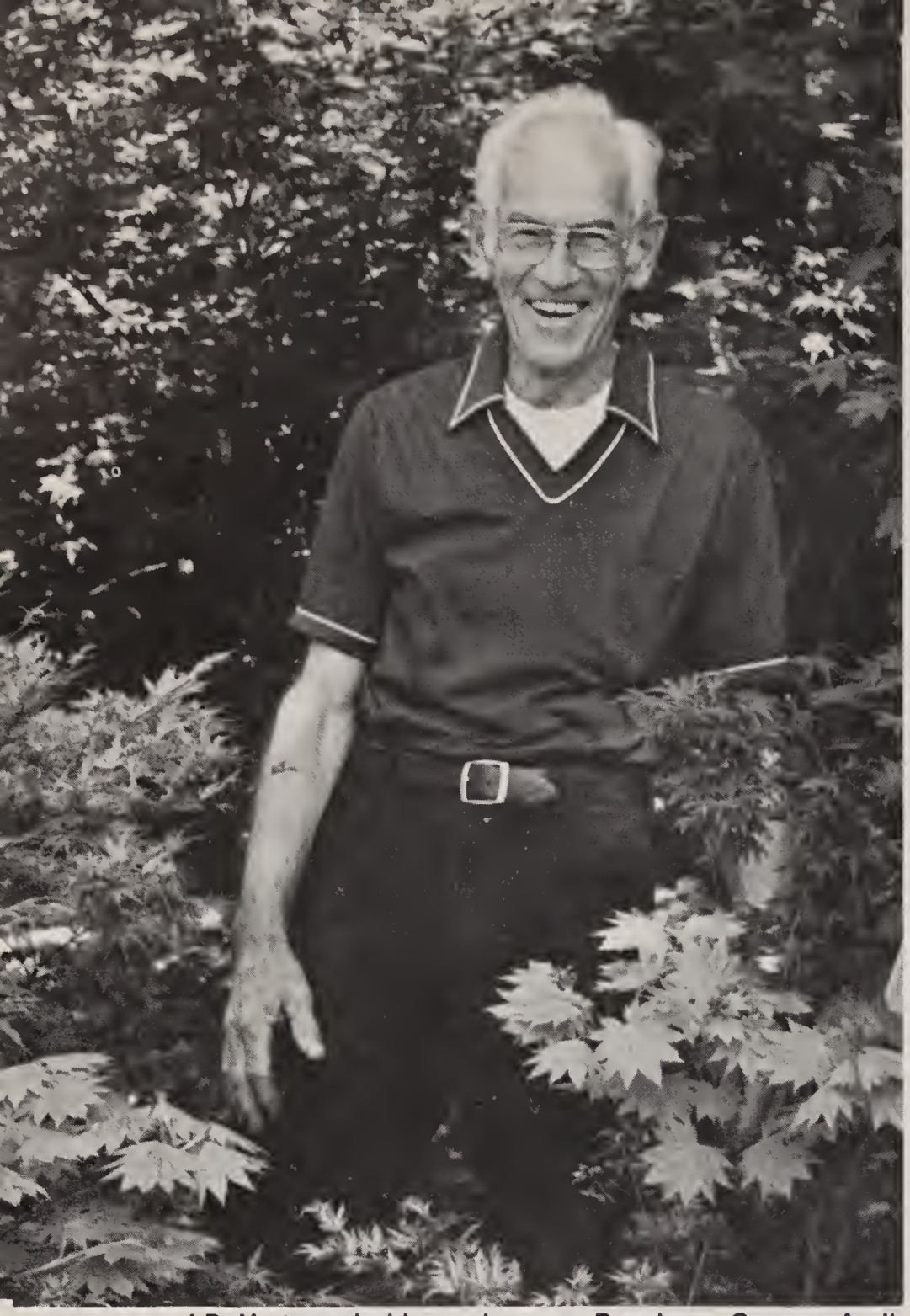
COVER
The native plant trail at the
Waipahihi Botanical Reserve
(see page 25).
Photo: J. Pirzio-Biroli



J.D. Vertrees in his garden near Roseburg, Oregon, April 1980. Photo: Brian O. Mulligan

Maples and Companion Plants in an Oregon Garden

*J.D. VERTREES**

The hope of ever having a private arboretum was always a distant dream with little chance of materializing. Fate finally decreed a move to the Roseburg, Oregon area where we obtained one and one-half acres along the North Umpqua River. In this mild climate[1] the growing of a large variety of plants was possible. The property had had no real use for many years and was covered with native growth dominated by poison oak, snow brush and "wild" blackberries. After we had hand-dug all unwanted brush, we found that the native trilliums, erythroniums, maidenhair and other ferns came out of hiding. We were blessed with *Calocedrus decurrens,* a gigantic *Acer macrophyllum,* plus other tree species which lined the river bank. These included choice species such as *Arbutus menziesii, Acer circinatum* and *Umbellularia californica.* What a place for an arboretum!

The Maple Collection

Since about 1940 we had had a latent interest in Japanese maples and other *Acer* species from Japan. While living in Portland, we continually enjoyed seeing magnificent old specimens of "thread-leaf" maples, a common term at the time. It was almost impossible to find much information about other types of these maples. Over the years we found a few planted in various arboreta, found one real authority in the East with about fifty named cultivars, but could find no published literature or descriptive references other than an occasional article in popular horticultural publications.

After moving to Roseburg, we started to collect cultivars and varieties from all possible sources. Before long, fortunately, we became acquainted

*Mr. Vertrees has the largest collection of Japanese maples in the United States and propagates them in his nursery in Roseburg, OR. His book, *Japanese Maples,* is the authoritative source on these attractive plants.

[1]The climate in this Umpqua River Valley is very gentle. Low temperatures range in the 20's to low 30's F for winter months. (Zero F was reached in December 1972, breaking a 70-year record!) Most summer temperatures reach highs of 80° to 90° F; it is unusual to reach more than 100°. Snowfall is rare in this area, but does occur briefly in some winters. Rainfall occurs mainly from late October into June, averaging between 32 and 35 inches per year. The summers are quite dry, making irrigation desirable. Our deep loam soils are slightly acid at pH 6.7.

with people in many overseas areas who were sources of small plants and/or propagating materials.

We decided to grow as many cultivars as possible, side-by-side, for comparative purposes. Our success in getting Japanese horticultural literature translated gave us additional information and soon showed that the world was full of synonyms in the Japanese maple group. The collection has grown to over 250 cultivars of *Acer palmatum.* In addition there are many more cultivars and varieties of closely related species, including *A. japonicum* and *A. shirasawanum.*

We are fascinated by the extreme variation in leaf coloration and plant form of Japanese maples. The cultivars range from tiny stubby types, through the various pendulous forms, to the fully upright shape of the species. The foliage varies among the cultivars through many shades of "reds", greens and variegates. Leaf shape will range from the extreme broad flat of the *heptalobum* group through the dissectums to the completely un-leaflike foliage of 'Beni maiko' and *'Garyu'.*

However, this is not the whole story. In the spring, many of the cultivars show brilliant foliage for at least a six- to twelve-week period. Some of them equal in brilliance the bloom of flowering shrubs in their attractively colored foliage. Then the entire picture changes with the coming of the fall colors. Some cultivars which have hidden their talents during the earlier year burst forth in extremely brilliant autumn coloration. This gives another four to six weeks of additional appreciation of colors in the garden. The warm tones are from butter yellow, through all the ranges of orange and red, to the brilliant crimsons which give a warmth of tone to fall days.

We also have collected many of the lesser known species of *Acer* from Asiatic regions, particularly from China and Japan. We continue to receive species new to us for the collection. We also enjoy some of the very "un-maplelike" maples: "evergreen" species such as *A. syriacum* and *A. orientale, A. laevigatum* with peach-like leaves, the pear-leaf type *A. albo-purpurascens,* and *A. carpinifolium* resembling the hornbeam. Many of the 70 or 80 species will become too large for us to have in this limited area and are being moved to a location for permanent care — close enough that we can still study, photograph and compare for continued interests.

Care and Cultivation of Japanese Maples

Japanese maples seem to be quite adaptable to a wide variety of conditions. This is evident when observing their performance in landscapes and arboreta on other continents. We see them in the chalk soils of England and, by contrast, in the peat soils of Holland at Boskoop. They are grown well and adapt almost everywhere in the United States from the colder northern tier of states to the Gulf area and from the Eastern Seaboard to the more arid Southwest. The Pacific Northwest states and British Columbia are particularly well adapted to these maples.

Blended in with a mixture of flowering shrubs, the maples need no special treatment in most landscapes. Fertilization requirements are usually minimal. Too much nitrogen will cause excessive growth, making poorly shaped landscape plants. A small amount of balanced fertilizer each year may be desirable in more impoverished soils. The evenness of water supply is most important. Overwatering may affect plant health adversely, although the plants should not become stressed for lack of water. This causes immediate leafburn and perhaps leafdrop. The variegated, dissected and "red" types appreciate some protection from

Maple path with *Acer palmatum* cultivars.

Photo: J.D. Vertrees

Left: Dwarf conifer planting. Right: *Acer palmatum* 'Crimson Queen' with companion plantings. Photos: J.D. Vertrees

hot afternoon sun and from drying winds. A sudden imbalance of moisture in the leaves will cause tip and edge burn. In extremely cold areas, landscape plants should have a mulch and winter protection of the root zone.

In containers, irrigation should not be irregular. Container-grown plants must have protection of the root area in temperatures below 15° F.

Pruning to shape the plants is recommended, even though most of us fear pruning on maples. It is easy for some cultivars to grow out of shape. Pruning encourages growth which will fill in the plant in an attractive manner. Prune according to your own personal tastes. All Japanese maples have a tendency to self-prune the small growth inside the plant as they become older. It is advisable to remove this dead wood continually, allowing a better view of the trunk and branch structure, which is one of the attractive features of Japanese maples.

Companion Plantings

Naturally a total planting of Japanese maples would be a sorry thing in a landscape — even in our arboretum, if we may call it that! Other plantings are a must to balance the total appearance. Our second loves are many — lilies, dwarf conifers, rhododendrons, Exbury azaleas, ferns and many other plants which we just can't resist.

Through the friendship of an avid hybridizer of Exbury azaleas, we have several dozen varieties of these beautiful deciduous plants. A large number of rhododendrons fill in with their evergreen foliage during the winter months. Both of these ornamentals add a riot of color from April to June. We are still taking out and putting in rhododendrons as we find types and varieties more to our tastes.

Through close friendship with several authorities in the United States and Australia, our collection of dwarf conifers continues to grow. The large number of cultivars and forms acquired over the years gives additional variety to the planting. They fill in admirably with the maples and rhododendrons and prevent monotony. One early mistake we made was trusting the term "dwarf" conifer. We should have planted only "miniature" conifers, since some of our dwarfs are pushing and shoving together! However, since we planted the entire area in a completely informal arrangement, we cannot object if the occasional plant oversteps its bounds into the neighbor. Time and good pruning shears will keep most of them looking proper.

Our interests also include ferns, spring bulbs and select hybrid lilies. These are also a must, to blend in and smooth out the harshness of a pure shrub planting. We try to have something in bloom every month of the year.

We would be remiss if we failed to mention the beautiful *Kalmia latifolia* selections. Dr. Richard Jaynes in Connecticut has done a great amount of work in hybridizing and selecting in this species of shrub and has developed a wonderful range of selected cultivars. In the Pacific Northwest we have not seen a great variety of kalmias available commercially. We know the native pinks and the beautiful Ostbo reds. Some of the new cultivars with silver flowers, the deep maroons, and those with deep color-banded blossoms are outstanding. We hope some enterprising nurseryman will obtain material and begin to produce some of the newer desirable forms and make them available. We have at least 18 named and numbered cultivars which have now reached blooming age.

The many forms and cultivars of European beech *(Fagus sylvatica)* fascinate us. While we do not intend to collect them as intensively as the maples, we do have about 20 cultivars plus three other species of *Fagus.* Of particular interest to us are the dwarf selections — in green, yellow

and red forms — mainly because they will stay small for us. The semi-dwarf 'Rohanii' is a particular favorite while the large 'Riversii' makes an accent tree in our planting. Many of the *Fagus* will soon become too large for permanent inclusion and will be placed in another nearby planting.

Of equal interest is the genus *Nothofagus*. I hope eventually to get a plant or two of each of the species which may be hardy in this zone. The dwarfer species *N. gunnii* from Tasmania holds particular interest as does *N. antarctica.* The very small leaves and the hardiness make this a candidate for more consideration in planting Northwest gardens.

Framing off the front yard and the driveway are quite a few large hybrid tea roses. This adds contrast and sets the "house yard" apart from the "landscape yard".

We have bordered the entire property with a hedge of the English hedgerow maple *(Acer campestre).* This is not only a most interesting hedge, quite fitting for an "Aceretum", but also a marvelous cover for a large variety of our favorite birdlife.

Any reader still with us this far will be thinking "what a jungle!" True, it would soon be that way and certain plants are becoming crowded. We are the first to recognize the risk in our penchant for "just one more plant". We are continually taking out and putting in and moving plants to weed out those of less interest. It is becoming a naturalized woodland containing the plants we like to grow.

We have been blessed with large numbers of interested visitors from across the United States, Canada and several overseas countries. We do like those persons with an intense interest in the types of plants we grow. We do not have as much patience with those who are just "sight-seeing on the park". We have been forced to state: "Visitors welcome — by appointment." When Brian Mulligan suggested we describe our collection and planting, we thought it might appear ostentatious since there are so many beautiful plantings in Northwest landscaping. However, we are hoping it may encourage some enthusiasts to seek out and plant a blend of some of the more unusual plant species and varieties which deserve more consideration in today's landscaping.

To give a list of "favorite" maples would take the entire issue of the *Arboretum Bulletin!* Almost all of the over 250 cultivars of Japanese maples are my favorites. The following list indicates some which have outstanding features of particular merit. We cannot include full descriptions for the sake of brevity. Complete descriptions of cultivars and species are now available in a recently published book on maples of Japan.[2]

A Selected List of Cultivars of Acer palmatum

Upright, full size

- *A. palmatum* species — green, small leaves
- *A. palmatum* var. *heptalobum* — green, larger leaves
- 'Bloodgood' — deep red
- 'Iijima sunago' — variable red color
- 'Nuresagi' — excellent red
- 'Samidare' — large green leaf
- 'Trompenburg' — red, interesting leaf shape
- 'Tsukushigata' — variable red

Dwarf type, shrubs, bonsai

- 'Beni komachi' — delicate red
- 'Coonara pygmy' — green
- 'Hanami nishiki' — tiny leaves
- 'Kamagata' — unique leaf, crimson in fall
- 'Kashima' — green
- 'Kiyohime' — green
- 'Kotohime' — green, stubby growth

[2]Vertrees, J.D. 1978. Japanese Maples. Timber Press, Forest Grove, OR.

Left: Exbury azaleas with rhododendrons and maples. Right: *Acer palmatum* 'Kamagata'. **Photos J.D. Vertees**

Deeply divided lobes
- 'Inazuma' — variable red
- 'Ki hachijo' — good green
- 'Kinran' — red to green
- 'Matsukaze' — interesting red-green
- 'Sherwood Flame' — good red
- 'Suminagashi' — good red
- 'Wou nishiki' — delicate green

Dissectums — cascading "shrubs"
- 'Beni shidare Variegated' — multicolored
- 'Crimson Queen' — deep red
- 'Filigree' — green with gold dots
- 'Garnet' — orange red
- 'Inaba shidare' — excellent deep red
- 'Palmatifidum' — different green
- 'Seiryu' — only upright *dissectum,* green
- 'Waterfall' — green

Linear-lobed leaves
- 'Red Pygmy' — red
- 'Scolopendrifolium' — green
- 'Shime no uchi' — green, delicate

Variegated leaf forms
- 'Beni schichihenge' — orange, white, green
- 'Butterfly' — white, green, twiggy
- 'Higasayama' — unique variegation
- 'Kasen nishiki' — pastel white marking
- 'Orido nishiki' — good white, pink, green
- 'Reticulatum' — yellowish, green veins
- 'Ukigumo' — dotted white, pink

Excellent fall colors
- 'Hogyoku' — orange
- 'Omurayama' — crimson
- 'Osakazuki' — crimson

Interesting winter bark
- 'Aoyagi' — green bark
- 'Sango Kaku' — coral bark

Unusual features
- 'Bonfire' — bright red spring growth
- 'Katsura' — new growth orange
- 'Koshimino' — green, feather leaf
- 'Okushimo' — rolled leaf edges
- 'Shindeshojo' — bright red spring growth
- 'Shishigashira' — stubby, crinkled leaves

Cultivars of Acer japonicum
- 'Aconitifolium' — fern leaf
- 'Aureum' — green-gold
- 'Green Cascade' — dissected, cascading growth

Favorite Species of Acer *in Our Planting*
- *A. buergeranum* and its cultivars:
  - 'Goshiki kaede' — white variegated
  - 'Mino yatsubusa'
- *A. campestre*
  - 'Postelense' — golden tones
  - 'Pulverulentum' — white dotted
- *A. carpinifolium*
- *A. circinatum*
  - 'Little Gem' — dwarf
  - 'Monroe' — fern leaf
- *A. distylum*
- *A. forrestii*
- *A. griseum*
- *A. lobellii* — columnar habit
- *A. maximowiczii*
- *A. mono*
  - 'Hoshiyadori' — gold flecked
- *A. morrisonense*
- *A. orientale* — evergreen
- *A. pensylvanicum*
  - 'Erythrocladum' — coral bark
- *A. pseudoplatanus*
  - 'Brilliantissimum' — pink and yellow tones
- *A. rufinerve* — colors well in fall
- *A. shirasawanum* var. *palmatifolium*
- *A. sieboldianum* — good fall color
  - 'Sode no uchi' — small-leaved form
- *A. syriacum* — evergreen
- *A. triflorum*
- *A. truncatum*
  - 'Akikaze nishiki' — white variegations

Dates to Remember

On Thursday, January 15, the Seattle Garden Club is sponsoring a lecture on "The Wildflowers of the Columbia River Gorge" at the Museum of History and Industry at 10:30 AM. Coffee will be served at 10. The speaker, Mrs. Bruce Russell of Portland, will show her own slides of the species, many of which are on the endangered/threatened list. The public is invited to attend.

The Friends of the Conservatory in Volunteer Park have reserved the afternoons of the second Sunday in each month for special displays. Sponsors will be: January 11, NOHS Fern Study Group; February 8, Cascade Cactus and Succulent Study Group; March 8, Washington State Primrose Society.

*As the **Bulletin** goes to press, the reconstruction work on the Japanese Tea House appears to be on schedule. The jointery of the poles and beams has been practically completed in Fred Sugita's shop. Mr. Kawasaki, his assistant, has arrived from Hiroshima, and together they will start assembling the myriad parts at the Tea House site. On December 23, the ridgepole ceremony was held, indicating a major step in the construction.* *KENNETH SORRELS*

The Origin and Development of the Japanese Tea Ceremony

RUTH VOROBIK

When next you go to the Japanese Garden, enter by the east gate, go to the bridge and look across the pond. Do you see several Japanese lords walking toward the tea house, dressed in the colorful garb of the 16th century? Before they reach their destination, let us think about the tea ceremony to which they have been invited.

THE ORIGIN OF THE TEA CEREMONY

This ceremony has been an important part of the Japanese culture for hundreds of years. Today, many Japanese people study and are trained in the formal etiquette of *cha-no-yu*. The actions of host and guests may be likened to the movements of a well-known classical ballet; the familiar moves, perfectly accomplished, contribute strongly to the mood of the gathering. It has taken many generations to develop this formal pattern.

Tea seeds were brought to Japan from China in the 8th century and the Emperor Shomu is mentioned as having invited monks to take tea in the palace after a religious service. In 760 a Buddhist priest in China wrote a book giving instructions for making tea. Since Japanese priests and members of the court were spending much time in China, absorbing its advanced culture, this instruction may well have influenced the ceremony in the beginning. At this time tea was used as a medicinal drink and was thought to cure many ailments. Only a small quantity of tea was imported and there were still only a few plants in temple gardens; so its use was limited.

A new surge of contact with China occurred in the 12th century when Japanese priests and scholars were attracted to China by the high level of culture at that time. Zen Buddhism was introduced to Japan. its priests spent long hours in meditation, and tea was helpful in keeping them awake. The green tea which Japan imported at this time was used in powdered form. The bamboo whisk used to whip the tea also was brought from China.

Essai, the priest who brought Zen to Japan, wrote a booklet on tea, emphasizing the health benefits of the beverage. There was a growing demand and larger tea plantings were developed. Among members of the court there were elaborate tea parties. A game developed in which guests were asked to identify the kind and origin of different teas: a cup of each kind was put before each guest and valuable prizes were offered for accurate identification. As more plantations and up to 100 different varieties of tea were developed, an unreasonable number of cups was required. Before the situation became completely out of hand, the custom developed of passing around one cup and wiping the edge after each guest had used it.

Gradually tea parties became more formal and often a special room in temple or palace was set aside for the ceremony. An alcove — *tokonoma* — containing scroll and incense, and, later, flowers, became a part of this room. Straw mats—*tatami*—were put on the floor. Monks or servants continued to serve the tea until the mid-15th century, when the Zen priest Shuko served tea to his guests himself. He preferred the intimate and personal atmosphere of a small room with no more than five or six people. By the mid-16th century there were several grades of tea-ceremony teachers whose professional abilities included flower arrangement, calligraphy, painting, architecture, and garden planning and planting.

The last half of the 16th century saw civil war again (as well as the entry of Europeans into Japan). The samurai warriors lived constantly with war and death. The tea ceremony became a form of retreat from worldly cares. It was at this time that a small, humble farm-style building in a special garden came to be designed for the ceremony — the tea house.

THE TEA CEREMONY IN THE *MOMOYAMA* PERIOD

This has been a sketchy view of the development of the tea ceremony up to and including that part of the 16th century called the Momoyama period. Juki Iida, designer and creator of the Arboretum's Japanese garden, wrote: "... the pond was designed after that of the Momoyama era in Japan." So it is not unreasonable to imagine that several Japanese lords are walking along the pond toward the tea house. They enter the tea garden by the gate at the *machiai,* a small waiting building. They sit in the peaceful surroundings without conversation. There is no distant view, as this is the beginning of withdrawal from worldly thoughts.

The sound of a small bell is heard and the first lord steps around the corner of the *machiai,* where he is greeted by his host; then he returns to his seat. After a short interval he rises and follows the garden path toward the tea house. The garden has been sprinkled just enough to give a feeling of freshness. The stepping stones lead him from one view to another so that he becomes aware of arrangements of plants and trees and stones. The trees create shade; the evergreens are somber. And the deciduous trees have small, pale or inconspicuous flowers. There are no disturbingly bright flowers or contrasting foliage. An exception might be the small-leafed maples, so colorful in the fall, or the winter-blooming plum. Stones of a kind that mosses will grow on have been selected for restful line and texture. The stone lanterns are in no way ostentatious. From the garden, the guest absorbs peace, a feeling of quiet oneness with nature.

The first lord continues on to a basin where hands and mouth are rinsed — a ritual cleansing of worldly stains from the spirit. Before entering the tea house, swords are placed on a rack and footwear left on a special stone. One by one the other lords follow at discreet intervals, increasing the feeling of solitude. Each guest enters the tea house through an entrance so low that, when inside, he is on hands and knees, an acknowledgement of humility and of the equality of all persons within the tea house.

The first guest appreciates the flowers, scroll and incense in the *tokonoma,* the fireplace and kettle, and then takes his place. Each guest follows the pattern, with the last one closing the sliding entrance door with just enough sound to signal the host that all have arrived. The host greets his guests and then proceeds with the tea ceremony. Conversation is about art, poetry, philosophy and the carefully selected objects used in the ceremony. The guests leave with a feeling of renewal, carrying the quiet mood of the garden into the outer world.

> All was ready. The first perfection of the *cha-no-yu* was cleanliness, the second, complete simplicity. The last and greatest, suitability to the particular guest or guests.
>
> He heard her footsteps on the flagstones, the sound of her dipping her hands ritually in the cistern of fresh river water and drying them. Three soft steps up to the veranda. Two more to the curtained doorway. Even she had to bend to come through the tiny door that was made deliberately small to humble everyone. At a *cha-no-yu* all were equal, host and guest, the most high *daimyo* and merest samurai. Even a peasant if he was invited.
>
> First she studied her husband's flower arrangement. He had chosen a single white wild rose and put a single pearl of water on the green leaf, and set it on red stones. Autumn is coming, he was suggesting with the flower, talking through the flower, do not weep for the time of fall, the time of dying when the earth begins to sleep; enjoy the time of beginning again and experience the glorious cool of the autumn air on this summer evening ... soon the tear will vanish and the rose, only the stones will remain — soon you and I will vanish and only the stones will remain (*Shogun,*p. 679).

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Plants as Air-Pollution Indicators

B.J.D. MEEUSE

INTRODUCTION

In the following article, there is very little that is original. The urge to write it came from the keenly felt conviction that in this era — with its steep increase in the burning of coal and wood, its exploitation of metal ores and the continued heavy use of automobile fuels — the American public should more than ever be aware of the dangers of air pollution. Apart from the health hazards for humans and livestock inherent in that phenomenon, there are other negative effects on the quality of life: damage — sometimes to the point of death — to trees and plants in parks and along highways; severe crop losses; and also the gradual erosion and defacement of statues, old buildings and monuments, as seen in cities such as Athens and Venice.

In earlier articles in the *Arboretum Bulletin,* it has already been pointed out that plant species and varieties intended to be grown in or near urban areas where there is a great deal of industry and traffic must be selected very judiciously, with emphasis on pollution resistance. Neglecting this viewpoint may lead to disaster. In a large, smog-infested area east of Los Angeles, for example, ponderosa pines have been dying off "like flies." Because coniferous trees are indeed very sensitive to air pollution, they can be used as pollution indicators. As early as 1853, Stockhart showed that pine and spruce trees become diseased when they are exposed to smoke containing sulfur dioxide. In general, deciduous trees such as ash *(Fraxinus excelsior),* sycamore maple (*Acer pseudoplatanus*), linden (*Tilia* species) and wych elm *(Ulmus glabra)* are more resistant, which makes them the trees suitable for urban areas. Birch (*Betula* species) and alder (*Alnus incana*), however, are not all that tough. Furthermore, when laying lawns in urban areas, one should heed the fact that some grasses are much more pollution-resistant than others. The extreme sensitivity of annual bluegrass (*Poa annua*) was brought to light in the Los Angeles area by Juhren and coworkers as early as 1957 (10)[1]. Other turf grasses that are highly sensitive, thus making good indicators, are *Festuca rubra* and *Agrostis stolonifera. Dactylis glomerata* and *Lolium perenne* are less vulnerable, while *Zoysia japonica* is highly resistant to air pollution (2).

Fig. 1. Map of the Netherlands showing the 31 stations with indicator plants used for monitoring air-quality in 1975 (5). Asterisks = stations; open circles = large cities.

Ironically, it may not be entirely unfortunate that some plants are so extremely sensitive to pollution. After all, constant monitoring of air quality over large areas — as already practiced in the Netherlands and West Germany, and also in the Los Angeles area, the San Francisco Bay region and Seattle — may soon have to become part of our lives! In the following, we hope to acquaint the reader with some elegant and sensitive methods, based on the use of plants, that perform such monitoring. To a botanist, it is most gratifying to discover that, as long as certain pitfalls are avoided, biological methods can in some ways be superior to the purely chemical ones.

[1]Numbers in parentheses refer to numbered references at the end of the article.

THE MAIN AIR POLLUTANTS TO BE CONSIDERED

Sulfur dioxide (SO_2). Combustion of fuels with a high sulfur content, such as certain types of coal and heating oil, will inevitably lead to the formation of sulfur dioxide. Not only will this gas by itself cause acute as well as chronic injury to plants, but also it may give rise (by chemical combination with atmospheric oxygen) to sulfur trioxide, SO_3; in turn, the trioxide reacts eagerly with atmospheric moisture to form sulfuric acid (H_2SO_4). The result is an acid aerosol, or even acid rain. Leaves receiving droplets of the deleterious aerosol on their upper surface tend to develop a punctate appearance, due to local necrosis (dying-off) of the plant tissues.

There can be no doubt that, on a global scale, sulfur dioxide is the most important air pollutant. According to the Environmental Protection Agency, about 80,000 tons of the gas enter the air of the United States — every single day! — from manmade sources alone. The largest SO_2 producer in Canada (and probably in the world) is the metal smelter in Sudbury, Ontario, which in a year of maximum production belches out an average of 8200 tons of SO_2 a day. Compared to this, Mount St. Helens, with its 500 to 2000 tons, looks like a mere midget.

Ozone (O_3) and Peroxyacetylnitrate (PAN). We mention these pollutants in one and the same breath because *both* are formed when sunlight acts on the gaseous hydrocarbons and nitrogen oxides released by automobile engines and industrial plants. Nitrogen dioxide, NO_2, absorbs ultraviolet rays from the sun, thereby gaining so much energy that "breakage" of the molecule occurs, with formation of nitrogen oxide (NO) and atomic oxygen (O). The latter is exceedingly reactive and gives rise to a number of oxidations; of course ozone is one of the main compounds produced. As we shall see, ozone can be injurious to certain plants in extremely low concentrations, measured as parts per hundred million (pphm). PAN, likewise, is extremely toxic to many plant species, inflicting its damage especially on seedlings and young leaves. Fortunately, it is unstable, particularly at temperatures above 90° F.

Nitrogen dioxide (NO_2). It is not only as a potential producer of PAN and ozone that nitrogen oxide is to be dreaded; it can also inflict damage all by itself. Its source is the combustion of coal, natural gas, fuel oil, and the type of gasoline used in power generators. At NO_2 levels of 2.5 parts per million (ppm), tomato seedlings have been found to show visible leaf damage after exposure times as short as four hours.

Fluorides. Most of the fluoride injury suffered by plants is due to gaseous fluorine compounds, including hydrogen fluoride (HF), which are readily absorbed by the leaves. It is fortunate that fluorides are not easily translocated from the leaf to other parts of the plant. The main sources of atmospheric fluorides are aluminum reduction plants, ore smelters and factories for the production of certain fertilizers and ceramics. Fluorides are toxic to some plants in concentrations as low as 0.1 part per billion (ppb).

Chlorine. Chlorine gas was the first poison gas used in World War I. It is well known that it plays a role in bleaches and disinfectants, and it is therefore not surprising that the damage it may inflict on plants is most often observed near swimming pools and sewage-disposal systems. The critical level for inflicting damage on plants is intermediate between the level reported for hydrogen fluoride, which is extremely low (see above), and that reported for sulfur dioxide.

Ethylene (C_2H_4). It is somewhat hard for this writer to picture ethylene, a very simple hydrocarbon, as one of the villains of our story. After all, it is a very "natural" gaseous compound, formed normally by plants, flowers and fruits at various stages of their lives. Sometimes it is referred to as the fruit-ripening hormone. Ripe apples, tomatoes, bananas, and various other fruits give off ethylene, and even at very low concentrations it will induce fruits that are still green to follow suit, that is, to start maturing more rapidly and to develop color. In flowers, and especially in orchid flowers, pollination and subsequent fertilization lead to an outburst of ethylene production, and it is this event that is mainly responsible for the spectacular post-pollination phenomena: conspicuous color changes and rapid wilting. Commercial orchid-growers, therefore, avoid at all cost having their flowers pollinated. In commercially used cut flowers, such as carnations, ethylene (which also is produced as a result of wounding) has been shown to have an adverse

effect on life span. For that reason, methods have been developed to eliminate the gas, either by binding it chemically once it has been formed (for example, with silver compounds), or by interfering with its normal generation by enzymes from its chemical precursors in the plant tissues.

In the present context, it is relevant to recall that the elucidation of the biological role of ethylene began with the observation that burning kerosene lamps had a favorable effect on the ripening of citrus fruits. Indeed, ethylene is formed as a by-product of many combustion processes, in low but biologically active concentrations. Not surprisingly, then, it is found mainly in the air of urban areas where there is a high concentration of heating systems based on fuel oil and natural gas, as well as of coal-burning industries and gasoline-powered vehicles. Neither is it surprising that ethylene damage complaints have come in especially from areas where flowers are raised commercially, such as Hawaii (orchids) and Los Angeles (carnations). *Cattleya* orchids allegedly develop sepal abnormalities after an exposure to 0.05 ppm of ethylene for six hours. An almost complete crop loss has been reported for a cotton field situated about one mile downwind from a polyethylene-plastic manufacturing plant. However, one still gets the impression that ethylene is not one of the really serious air pollutants.

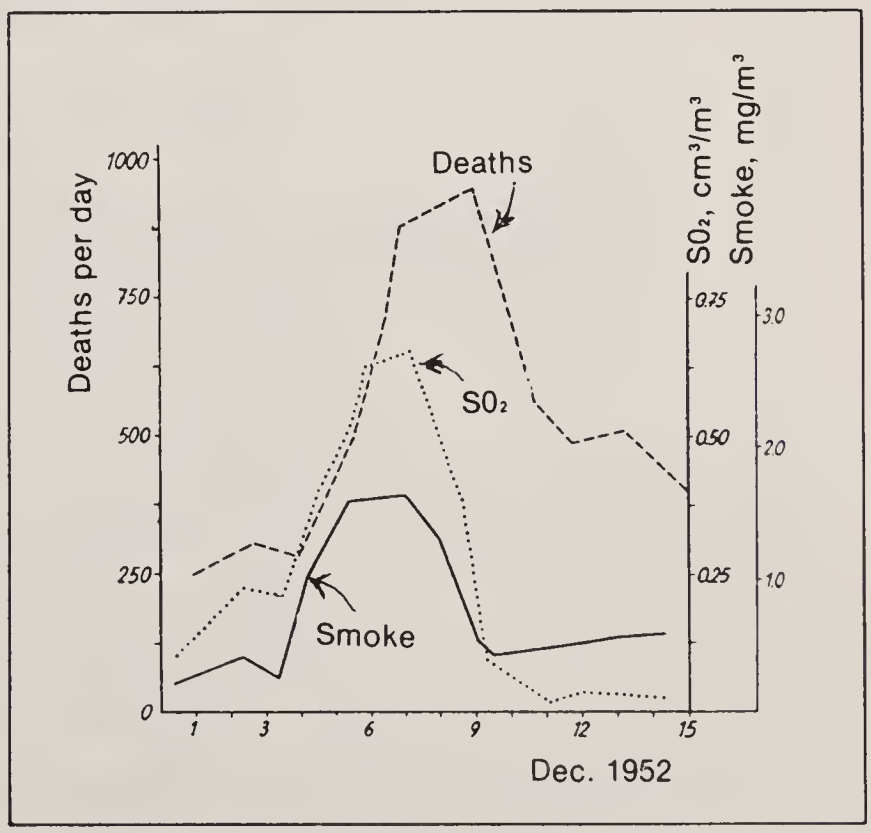
Carbon monoxide (CO). It is well known that incomplete combustion of carbon and hydrocarbons, such as that which occurs in coal-burning factories and in automobiles, produces carbon monoxide. Colorless and odorless, this gas can be fatal to humans even in very low concentrations. Carbon monoxide is also one of the deleterious components of cigarette smoke, but the same low concentrations that are so harmful to humans do not seem to have much effect on plants. In the gas that fills the hollow floats of our big brown kelp (*nereocystis luetkeana*), carbon monoxide is found in concentrations ranging up to 12% (average: 4%). Sparrows placed in an airtight box containing the collected kelp gas perish very quickly. While the reports issued since 1971 by the Puget Sound Air Pollution Control Agency referred only to the level of sulfur dioxide and particulates measured in the air by the Agency's instruments, a newly adopted policy conforming with the federal system of reporting will, from now on, present data on carbon monoxide also. However, it seems doubtful that plants can be roped in for the study of this aspect of air pollution.

CHOICE OF INDICATOR ORGANISMS

In principle, the environment works on all living creatures, and consequently there is in the study of air pollution a whole array of organisms to choose from for use as living indicators. Among the oldest are canaries. Like other warm-blooded creatures, these birds are very sensitive to carbon monoxide. Miners, therefore, kept them in cages in the areas where they did their daily work. A dead or dying canary meant that it was time to evacuate the mine. Cattle, grazing in pastures exposed to an atmosphere containing fluorine compounds such as HF, have a high urinary level of fluoride. The closer the cows are to the source of the poisonous products such as a smelter, the higher the fluoride level. Even humans can inadvertently act as "reagents"; unfortunately, their negative reaction to air pollutants, sometimes leading to death, normally comes too late to make last-minute preventive measures possible (see Fig. 2). Furthermore, it needs no emphasis that cows and humans are somewhat too unwieldy and expensive to be used on a regular basis, to say nothing of the difficulties of exact statistical evaluation.

A priori one can say that plants, preferably young plants of one species and one age, available in large numbers, offer advantages in air-pollution studies. The fact that they normally stay

Fig.2. Relationship between the number of human deaths in London in December 1952 and the SO_2- and smoke-content of the air.



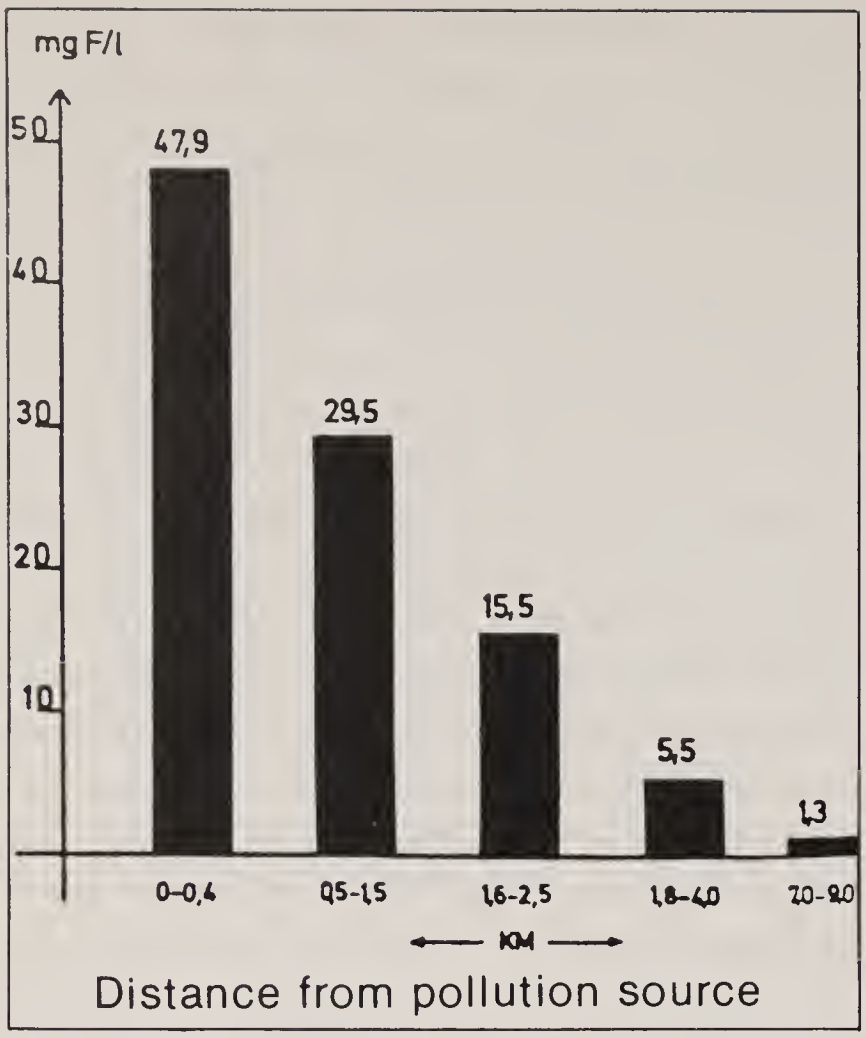


Fig. 3. Urinary fluorine content of cattle at different distances from the pollution source, according to Alther.

in one place and lack the ability to escape bad influences by running, flying or digging also is important. Lower plants, such as bacteria, mosses and especially lichens are among the best to use, but a number of species of flowering plants, both wild and cultivated, have also been shown to be excellent subjects (see Table I). Comparing their reactions to air pollution, one often finds that family relationships make themselves felt. For example, in some taxonomic groups, there may be a special sensitivity toward ozone, in others toward PAN. Thus, plants not only can be used as *general* pollution indicators, alerting us to the danger and making it possible to locate or even pinpoint the trouble spot(s) geographically; but also they may tell us what *specific* pollutants to look for. The next step could be to perform separate chemical analyses of comparable plant individuals collected over a wide area, in order to determine in each the level of the suspected pollutant (for example, fluoride). On the lee side of the pollution source, one might find a gradual drop-off in that level with increasing distance from the source, whereas on the opposite (windward) side distance would not make much difference (see Fig. 3). From the initial observations, which will, of necessity, be of a *qualitative* nature only, one can thus arrive at some sort of quantitative measurement. *However,* a number of factors may obscure the picture, or even create a false one, and the time has come to examine some of these.

Pitfalls in the Use of Indicator Plants, and How to Circumvent Them. Plants are naturally subjected to a whole array of influences from the environment, and sometimes these are hard to assess, at least in their individual effects. Two things are certain:

a) even comparable plants of one variety and age will be exposed to different influences when they grow in different locations; it is almost predictable, for example, that the soil and the water-supply will not be exactly the same;

b) even if they grow *very* close together in one site, they may react to the environment in different ways as the result of genetic variation found in living organisms.

Table I. Plants suitable for use as air pollution indicators.

Common name	*Species*	*Pollutant*[1]
Alfalfa	*Medicago sativa* 'Du Puits'	SO_2 (O_3)
Buckwheat	*Fagopyrum esculentum*	SO_2 (O_3, NO_2, HF)
Clovers:		
crimson clover	*Trifolium incarnatum*	SO_2 (O_3)
hop clover	*Medicago lupulina*	SO_2 (O_3)
red clover	*Trifolium pratense*	SO_2 (O_3)
white clover	*Trifolium repens*	SO_2 (O_3)
Gladiolus	*Gladiolus gandavensis* 'Sneeuwprinses' and 'Flowersong'	HF
June grass	*Poa annua*	PAN
Nettle	*Urtica urens*	PAN (O_3, SO_2)
Petunia	*Petunia nyctaginiflora* 'White Joy'	PAN (O_3, NO_2, C_2H_4)
Rye grass (Italian)	*Lolium multiflorum* 'Optima'	HF, HCL, SO_3; heavy metals (cadmium, lead, zinc)
Spinach	*Spinacia oleracea* 'Subito'	O_3 (SO_2, NO_2)
Tobacco	*Nicotiana tabacum* Bel W_3	O_3 (SO_2, NO_2)
Tulip	*Tulipa gesneriana* 'Blue Parrot' and 'Preludium'	HF

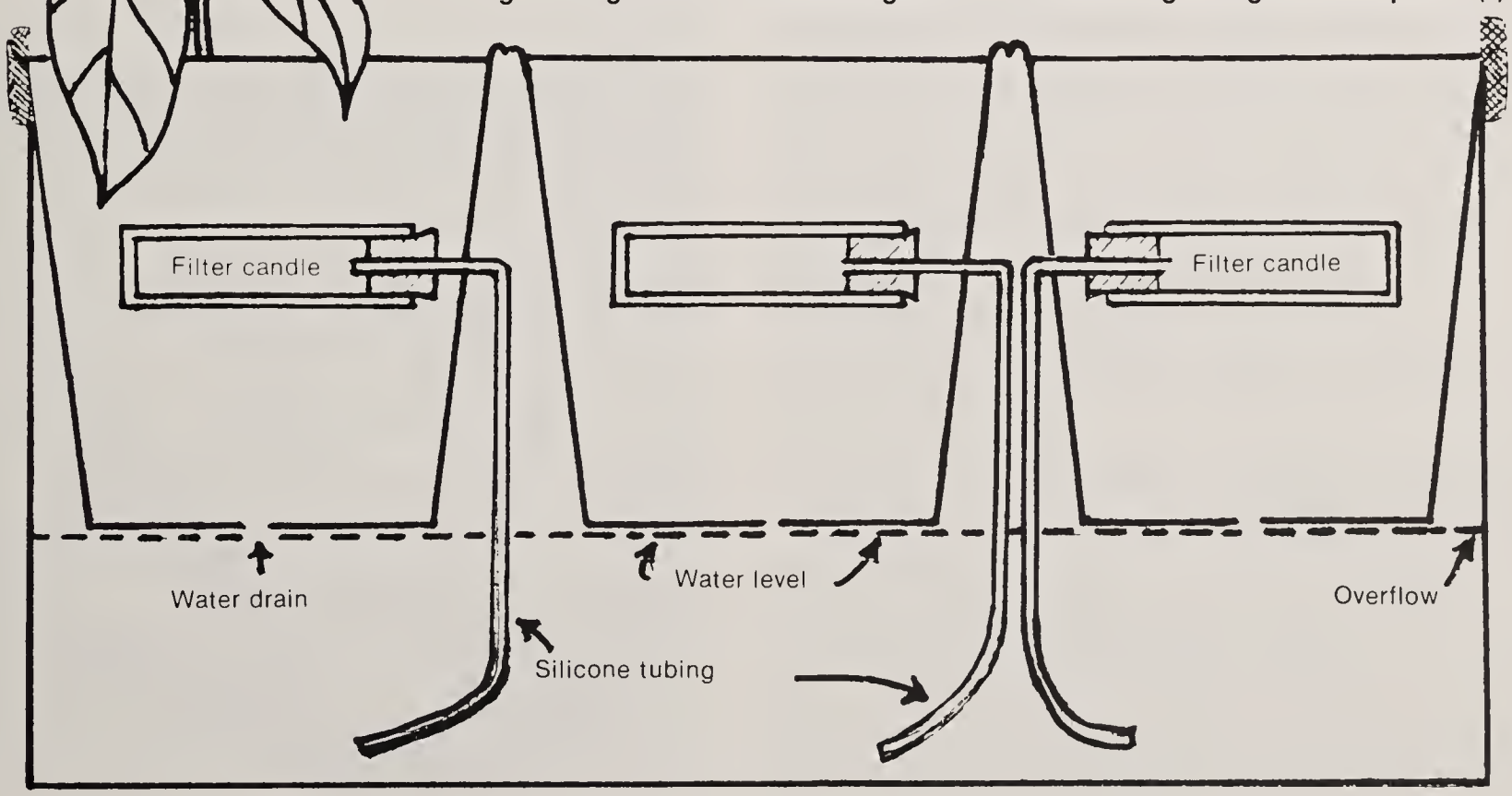
[1]The main sensitivity is toward the agent that is *not* in parentheses.

By using or observing large numbers of plants, this effect can, statistically speaking, be minimized, but who can say that suitable indicator plants are sufficiently abundant in the landscape to make that possible? (They might even be lacking totally). Fortunately, the difficulties indicated here can be solved to a large extent by using standardized methods in which carefuly chosen, similar test plants, raised artificially in a pollution-free environment under strictly controlled conditions, are exposed to the contaminated environment in a number of sites, where non-atmospheric factors can, again, be carefully controlled. The plants are examined and evaluated at regular intervals, which could be days, weeks or even years. One batch of test plants (the "control") is exposed to the atmosphere in a non-polluted area, another within the suspected area. The plant individuals of both batches are grown in pots which always contain the same type of soil and a uniform water supply (Fig. 4). Under these circumstances, one can obtain additional information on the build-up of toxic materials *in the soil* by adding increasing amounts of soil from the polluted area to the clean standard soil used in the pots.

For evaluating contamination by fluorine compounds, a variation of the above technique known as "Scholl's grass-culture method" has proved to be very valuable. Well-defined mixtures of certain grasses (*Lolium multiflorum* and *L. perenne*) are cultivated in plastic containers under standardized conditions and are then simultaneously exposed to the atmosphere in a number of sites. In an investigation carried out in the highly industrialized Ruhr region in Germany, the sites were linearly arranged in a north/south direction, at one-kilometer intervals. The fluoride level was highest in the center of the region, so high that it formed a potential danger to cattle, and dropped off at both ends. Another variation of the test-plant method, developed in the United States, involves the tobacco variety Bel W_3, which shows an extreme sensitivity toward ozone. This particular tobacco has shown its mettle as a test plant in West Germany also.

Test-Chamber Methods. In those cases where it is impossible to employ the test-plant method because the climate varies too much from one site to another, or because unpolluted control sites are hard to find, one can resort to the test-chamber method. In one and the same site, comparable plants kept in plexiglass chambers are exposed either to unfiltered air or to air robbed of

Fig. 4. Lengthwise section through container used for growing indicator plants (5).



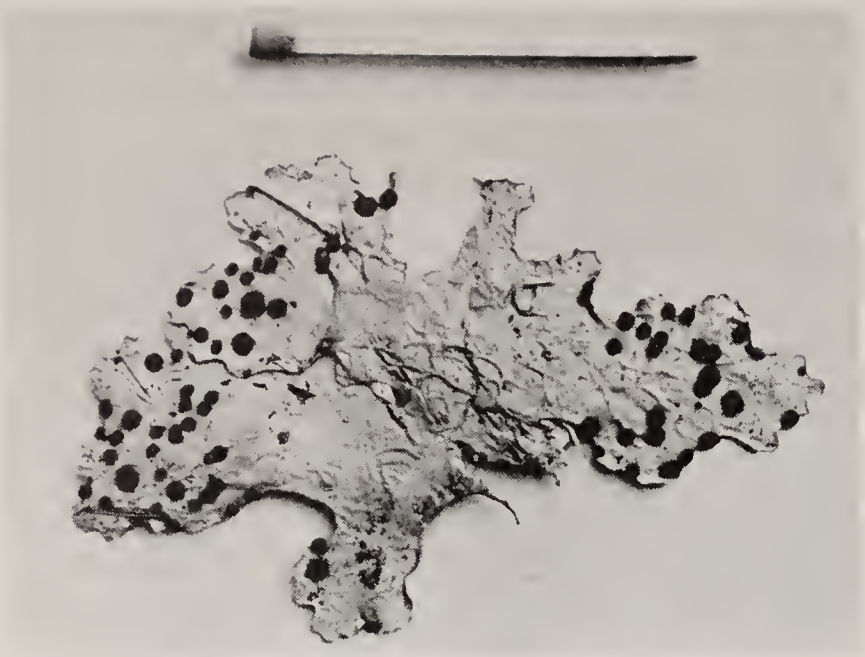


Photo: B.J.D. Meeuse

The lichen *Lobaria pulmonaria* requires very clean air.

its pollutants by suitable filtration methods. In the case of fluorine pollution, begonias kept in the chambers with unfiltered air clearly show damage, while the control plants in filtered air remain healthy. A great advantage of this method is that the relatively small chambers can easily be transported to a wide variety of sites.

Use of Lichens. It has long been known that certain types of lichens are excellent pollution indicators. They are particularly sensitive to sulfur dioxide, SO_2. Thus, Skye (15) found in 1968 that a concentration of SO_2 in air of 0.05 ppm was harmful to a species of *Cladonia,* a fruticose lichen. Qualitative data are much older: more than a century ago, Nylander (12) already noticed that the number of lichen species in Paris was lower than that in the surrounding countryside which was relatively pollution free. Sernander (15) coined the term "lichen desert" for the central areas of cities where tree-dwelling lichens are lacking, and the term "struggle zone" for areas with only a few such arboreal lichen species. In Finland and Scandinavia, where clean areas for comparison are still fairly common, lichen mapping has been carried out in Oslo, Helsinki and Stockholm. With the aid of 10,000 volunteers, and by concentrating on key indicator species, mapping of air quality has also been done for the whole of Britain (11). In our Pacific Northwest, there have been two such studies, one by W.C. Denison (3) for the Willamette Valley in Oregon, and one by D. Johnson (9) for Seattle.

In work of this kind, standardization and precision are very important. For instance, it is a matter of simple observation that some tree species are much better as lichen hosts than others; the chemical composition of the bark as well as its texture must be among the important factors responsible for the differences. It follows that in our comparison of different geographical areas, or sections of a city, it is imperative always to look at lichens growing on the *same* tree species. Denison chose Oregon ash (*Fraxinus latifolia*) and Oregon white oak (*Quercus garryana*), while Johnson zeroed in on big-leaf maple (*Acer macrophyllum*).

Another variable that merits attention is the age of the branches on which the lichens are found. Clearly, a very young twig has not had sufficient time to accumulate much lichen growth even under the best possible circumstances. In addition, the composition of the lichen flora on young branches may be different from that on older ones because species that appear early may in time be replaced by others in a continuing succession. By always examining the lichens on branches of the same age, the differences due to different exposure times can be circumvented. Denison used five- and ten-year-old twigs, while Johnson examined the lower part of the trunk of his big-leaf maples.

Denison found that *Lobaria pulmonaria* and *Physcia aipolia* are found only in regions with *very* clean air. At the other end of the scale of pollution tolerance, we find such species as *Parmelia sulcata* and *Xanthoria polycarpa* which can maintain themselves even in the more highly polluted areas of big cities.

Johnson sampled lichen species at 85 sites within the city of Seattle. The data obtained were used to construct a map consisting of five zones, so that the different composition of the lichen

***Hypogymnia physodes,* a pollution-tolerant lichen.**

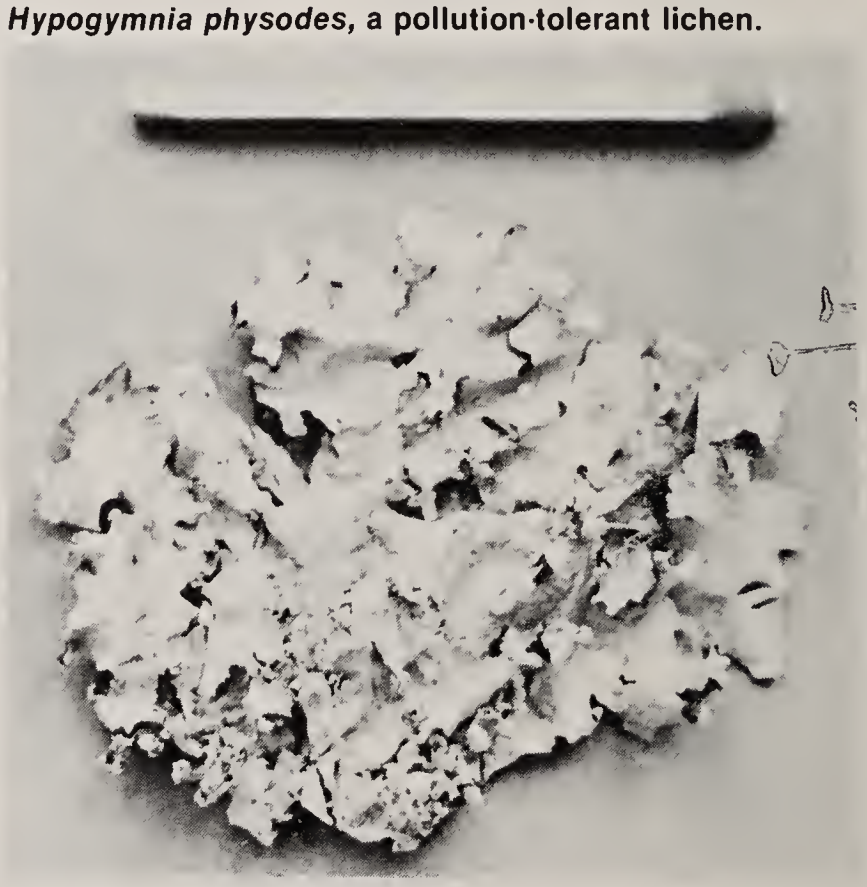


Photo: B.J.D. Meeuse

floras in these zones reflected certain air-pollution gradients observable within the city. These gradients, in turn, reflected not only the land use patterns (presence or absence of industry) but also the direction of the prevailing winds (southerly), as well as the interesting geographical and topographical situation of the city with its many hills and the two large bodies of water on its eastern and western sides. The most pollution-tolerant species were found to be *Hypogymnia physodes, Parmelia sulcata, Physconia grisea, Lecidea scalaris* and *Candelaria concolor. Parmelia perlata* and *Parmeliopsis ambigua* were not found in the most strongly polluted area. *Usnea hirta* and *Evernia prunastri* occur in areas that are almost pollution free.

Descriptive work of the type exemplified by these publications can teach us a great deal about the atmospheric conditions that prevailed in a given area over a period of perhaps years. However, in many cases we are interested in the here-and-now, so that more dynamic, experimental methods should also be considered, for example, the following one. Pieces of *Parmelia physodes,* a common foliose lichen, can be mounted on special "exhibition tables" (pieces of board), transported to any area one wants to investigate for pollution, and exposed to the atmosphere. It has been demonstrated that in non-polluted areas the lichen will continue to grow even under these unnatural conditions. However, exposed to air which contains SO_2 or HF, the lichen will die off, as evidenced by the appearance of whitish areas. It is not hard to show that, within certain limits, there is a positive correlation between the rate of dying off and the level of air pollutants.

An interesting difference between lichens and higher plants comes to light when one evaluates the effect of, respectively, level of pollutant and duration of exposure to pollutant. High concentrations of pollutants working over a brief time span are more damaging to higher plants than they are to lichens, while a long-lasting exposure to low levels is better tolerated by the higher plants. In addition to lichens, certain moss species lend themselves very well to transplantation and exposure experiments of this type. In 1966, Czaja developed his *Mnium* test, which makes it possible to evaluate in a simple and quick way the effects of certain dust particles on living cells of the moss *Mnium punctatum.*

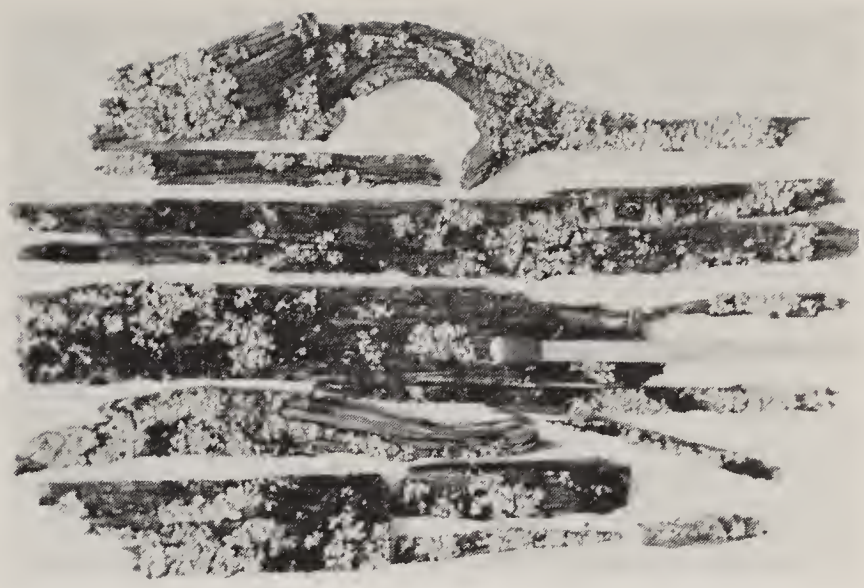


Photo: B.J.D. Meeuse

Parmeliopsis ambigua, **a lichen that cannot tolerate heavy pollution.**

EPILOGUE: WHERE DO WE GO FROM HERE?

From the above, it is clear that we have gone a long way in roping in plants as our allies in the study of air pollution. However, a great deal remains to be done; some good new ideas are in the process of being tested right now. Damage to plants will be assessed in the near future at a number of different levels, with ever-increasing sophistication. What do electron microscope photographs of the tissues of plants exposed to pollution reveal? Can it be shown that there is damage to pollen? Which enzymes are the most vulnerable to pollutants? Can the combined effect of two pollutants (for example ozone and sulfur dioxide) be larger than the sum of the individual effects — or could it, surprisingly, be smaller? There is some evidence for the latter possibility! The coming years will undoubtedly show some interesting develpments in this area of endeavor.

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[2]A more extensive bibilography, comprising 43 items, can be obtained from the author.

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Photo: E.F. Martin

***Alnus glutinosa*, with male catkins 2 1/2 to 3 inches long and female inflorescences 1/8th to 1/4 inch long on the branches above them, blooming in the Arboretum in March.**

A New Study of American Species of *Alnus*

Attention should be drawn to a recent and thorough study of the genus *Alnus** on the American continents by Dr. John J. Furlow, published in two parts in *Rhodora,* the Journal of the New England Botanical Club, at Cambridge, Massachusetts, Volume 81, Numbers 825 and 826, 1979.

The first part deals with the origin of the genus, its dispersal, ecology, morphology, reproductive biology, phylogenetic trends and taxonomic treatments. Keys are supplied for three subgenera *(Alnus, Clethropsis,* and *Alnobetula,* eleven species, including one naturalized in the northeastern USA and southeastern Canada (*A. glutinosa)*, and their infraspecific taxa.

The following species are described in detail, with distribution maps and illustrations of herbarium specimens: *Alnus rubra, A. oblongifolia, A. rhombifolia,* and *A. acuminata.* Here, a nomenclatural change reduces the Mexican *A. glabrata* Fernald to a subspecies of *A. acuminata* H.B.K.

In the second part of the work, the following species are described: *Alnus jorullensis,* with a newly recognized subspecies from Mexico, *lutea* Furlow; *A. incana,* with two subspecies, *rugosa* and *tenuifolia; A. serrulata; A. glutinosa,* escaped and naturalized; *A. viridis,* with two subspecies, *crispa* and *sinuata;* and *A. maritima,* found in Delaware and Maryland but also with a disjunct population in Oklahoma.

Dr. Furlow follows other earlier but generally recent students or authors in reducing four frequently recognized species to subspecies: namely, *Alnus rugosa, A. tenuifolia, A. crispa* (which is chiefly Canadian in its range), and *A. sinuata* (from Alaska, the western USA and Canada and with much the same distribution as *A. tenuifolia).* There is an extensive bibliography and a comprehensive "Index of Names of Species and Infraspecfic Taxa", covering twenty pages between them. *B.O.M.*

*The Arboretum collection contains at least nine North American species or subspecies.

Ilex altaclarensis 'Camelliaefolia'. Photo: William Eng.

English Hollies In Seattle

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Royal Botanic Gardens, Kew

In the Autum of 1979, I spent five weeks in North America on a study visit. My objectives were to make contact with people interested in and working with hollies and to visit herbaria and collections of *Ilex,* both in cultivation and in the wild.

Joe Witt had mentioned the previous year at a conference in Kew that there was an interesting collection of *Ilex* at the University of Washington Arboretum. I arrived on the West Coast in mid-October just as the autumn colour was turning. Everything looked very lush and healthy. Having come from the East Coast, it was obvious to me how much better English hollies were suited to the Northwest. But I was disappointed to see few people growing them.

Ilex aquifolium, the common holly, is native to Europe, western Asia and North Africa. This species has crossed with a complex of hollies from the Atlantic islands (the *I. perado* complex) to produce the *I.* X *altaclarensis* hybrids. *I. aquifolium, I.* X *altaclarensis* and their cultivars are known as the English hollies.

Ilex aquifolium produces male and female flowers on different trees. Its berries are bright red and it can make an excellent specimen tree, hedging or undergrowth in woodland. The best yellow-berried cultivar is 'Fructu Luteo' while 'Fructu-Aurantiaca' produces fine orange fruits.

The following cultivars of *Ilex aquifolium* are worthy of note and all of these can be seen in the *Ilex* collection at the Arboretum:

'Argenteo-Marginata', the silver variegated holly. A very old female cultivar, it has dark, glossy green leaves with a cream margin. The emerging new growth is shrimp pink in colour and is quite striking. This fruits reliably and makes a very good specimen plant or hedge. A.G.M.[1] 1969.

'Angustifolia', one of the most popular of the small-leaved cultivars. The black-green, lanceolate leaves are distinctive. It is erect in habit and slow-growing. Both male and female forms exist.

'Aurifodina', also known as 'Aureo-Marginata Angustifolia' or 'Muricata' in the past. Its most spectacular feature is the golden edge of its leaves which turn a magnificent tawny gold in winter to early spring. A good fruiter, it is very effective in a dark corner.

'Golden Milkmaid', a golden-blotched female which, like all the centrally-variegated hollies, tends to revert totally unless the reversions are removed. This is female but does not produce much fruit.

*The author works on Aquifoliaceae at Kew and has a special interest in *Ilex*. She traveled to North America with the aid of a grant from the Stanley Smith Travel Fund.

[1]A.G.M. = Award of Garden Merit, given by the RHS, London.

'J.C. van Tol', a Dutch cultivar, which is one of the few parthenocarpic cultivars. The almost spineless leaves are dark glossy green and large crops of red berries are produced. A.G.M. 1969.

'Laurifolia', the laurel-leaf holly. A superb specimen plant producing large quantities of male flowers. The spineless, black-green leaves set off the purple stems.

'Madame Briot', a large-leaved, golden-margined cultivar originating probably from France. This also has purple stems and produces plentiful fruit. A fine specimen. A.G.M. 1969.

'Pyramidalis', an attractive small tree with dark glossy green, often spineless leaves. A free-fruiting cultivar. A.G.M. 1969.

'Rubricaulis Aurea', another golden-margined holly but with red-brown stems and petioles. The spines are red-tipped. Somewhat slow-growing, it will eventually form a small tree. Bright scarlet berries.

'Scotica', a very old female holly with thick, bluntish rounded, dark green leaves. It has no spines. An interesting plant.

The *Ilex* X *altaclarensis* cultivars are very vigorous and have large handsome leaves. Many make good hedges or solitary specimens. They are extremely tolerant of pollution and maritime exposure.

'Camelliaefolia', an excellent specimen plant of pyramidal habit. The long, large, usually spineless leaves are shining green. The stems and petioles are purple. It has large, bright red fruit. A.G.M. 1931.

'Hendersonii', a vigorous female used for hedging and solitary planting. This has dull green, oblong leaves which are semi-spiny.

'Hodginsii', a strong-growing male, and occasionally a female, cultivar with purple stems and large black-green leaves. The older leaves are much less spiny than the newer growth. A magnificent specimen tree. A.G.M. 1969.

'Nobilis Picta', this is a golden-blotched sport of 'Hodginsii' in spite of its name. Always male.

'Wilsonii', a superb tree with large, very spiny, broad leaves; bright glossy green in colour with prominent venation. Large red berries are produced. A.G.M. 1969

For those who are interested, the Holly Society of America has a Pacific Northwest Chapter and details can be obtained from Dr. August Zoet, 214 Highland Drive, Bellingham, WA 98225.

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The Arboretum Foundation Unit Council
is sponsoring its

Fourth Annual Horticultural Exhibit

at the

NORTHGATE MALL

(new location!)

Featuring mixed floral displays and educational exhibits.

Saturday, March 28, 9:30 AM - 6 PM

Sunday, March 29, 11 AM - 5 PM

Photo: J. Pirzio-Biroli

Bole and crown of mature Kauri tree, about five feet in diameter and possibly 1000 years old. Waitakere Ranges (see page 21). The epiphytes are ferns and a species of the lily family.

Springtime in New Zealand—Part I

The Arboretum's Horticultural Tour

October and November 1980

JAN PIRZIO-BIROLI

This autumn, the Arboretum sponsored, through the UW College of Forest Resources, a horticultural tour of New Zealand, led by Joe Witt, Curator of Plant Collections, and his wife Jean. Nineteen persons, including two from British Columbia and one from California, accompanied them. Travel in New Zealand was by chartered bus, and accommodations were in first-class hotels, primarily in centers of population on both the North and South islands. The following is a description not so much of the tour itself as of the natural areas, the gardens and other facilities we visited, as well as of the native and introduced floras as they affect the landscape of New Zealand.

Impressions

For all of us, the island country of New Zealand presented a study in contrasts. The English language is used but is spoken in an accent we understood with difficulty. The small, well-kept suburban gardens contain exotics and New Zealand natives we had never seen, except perhaps in picture books or glasshouses, as well as many of our old garden favorites. In the cities, ultra-contemporary high-rises stand side-by-side with Victorian dwellings and turn-of-the-century neoclassical office buildings; and, most remarkable of all, there are Anglican churches decorated with Maori carvings — a somewhat surprising effect, yet totally in keeping with the New Zealanders' mixed heritage.

Some things remained constant, however. Everywhere we encountered the courtesy and general good humor of New Zealanders and the pervasiveness of the Maori culture (botanists even use the Maori names for native plants). Every city boasts numerous and very beautiful parks, and there are "town belts" where the native flora has been preserved. Mile after mile of countryside has been stripped of its native vegetation and replanted either with stands of Monterey pine *(Pinus radiata)* or with pasture grasses, and the hillsides are covered with gorse *(Ulex europaeus)* and Scotch broom *(Cytisus scoparius)*, introduced by early settlers and now considered rampant pests. And there are sheep! New Zealand has a population of three million persons; there are 65 million sheep and an annual "lamb drop" of 40 million. Sheep-watching became a favorite pastime during the long bus rides between destinations.

A proteaceous plant in the garden of a typical New Zealand dwelling built in the early 1900's. Photo: J. Pirzio-Biroli

Flora

We quickly learned that there were interesting but sometimes perplexing vegetative characteristics of the native flora that make identification difficult without flowers or fruit. The divaricate branching habit of such a familar New Zealand plant as *Corokia cotoneaster* is repeated in numerous species from various genera; divaricating shrubs are nearly unique to New Zealand. Many evergreen species representing different genera — even families — seem to be indistinguishable, for all of them have either: broad, thick, glabrous leaves; relatively thin, crinkly leaves; small, more or less round leaves on thin stems; small, linear leaves; or small, thick leaves with heavy indumentum in various colors. But most difficult of all is the fact that many species (and, in fact, whole genera) have juvenile and adult foliage which may differ entirely from each other. As Americans, we are, perhaps, most familiar with this phenomenon in *Eucalyptus* and juniper. After our first garden visit, Joe Witt remarked with characteristic quiet humor, "When in doubt, call it a *Coprosma*." That afternoon, we were informed by a bontanist that *Coprosma* is the only genus native to New Zealand that has opposite leaves and stipules; at least we were able thereafter to recognize *Coprosma* in its many vegetative forms.

Coprosma is also typical of the New Zealand flora in that it is frequently, but not always, dioecious (that is, having male and female flowers on different plants). Dioecism is present in a high percentage of New Zealand plants and frequently in genera which are bisexual as we know them, even in the several endemic species of *Clematis*.

There are other characteristics of the New Zealand flora that deserve mention. Thorniness occurs in several genera and in the juvenile foliage of others. There are brooms, that is, plants with green stems and few or no leaves, and there are broad-leaved conifers: *Agathis* (known by the Maori name "Kauri") and *Phyllocladus,* whose leaves are analogous to those of the more familiar *Ginkgo*. The numerous cushion or mat-forming plants are exemplified by the genus *Raoulia,* of which 20 species are endemic in New Zealand while only a few others are know in New Guinea. And there is endemism itself.

Several aspects of the New Zealand flora contribute to its exotic, often tropical, appearance, even through New Zealand is a temperate country. There are numerous lianes (or vines) in some areas of the bush, occasionally so rope like that they recall Tarzan's exploits in the jungle. Often the trees are covered with epiphytes — mosses, ferns, orchids, bromeliads and other monocots, and dicots, especially certain species of *Metrosideros* called by the Maori name "Rata". Two genera of tree ferns, *Cyathea* and *Dicksonia,* occur throughout the islands, even in areas that experience frost.

Many characteristics of this unique flora are due to the geologic history of New Zealand as an island that broke away from the mainland of Gondwanaland in ancient times. Contributing factors are the wide range of climate, altitude and latitude. For a more complete discussion of the evolution of New Zealand's flora, the reader is referred to Carlquist's *Island Biology* (1974).

THE NORTH ISLAND

Auckland

After more than 16 hours in transit, we landed in Auckland early on Sunday morning. As we drove through the nearly empty streets, we recognized many familiar exotics such as

Eucalyptus, 100-foot tall Norfolk Island pines *(Auraucaria heterophylla), Callistemon lanceolata,* rhododendrons and azaleas, *Clematis montana* var. *rubens, Valeriana officinalis* and many other flower-garden annuals and perennials that we would expect to see at home. One striking proteaceous plant had four- to five-inch light orange inflorescences. A few of the native plants that we were able to identify — usually through Joe, and sometimes with the help of Bruce, our driver — were the cabbage tree *(Cordyline australis),* New Zealand flax *(Phormium tenax),* and the New Zealand Christmas tree (Pohutukawa or *Metrosideros excelsa*) which is related to *Callistemon* (family Myrtaceae) and has similar inflorescences, appearing to be large round clusters of brilliant red stamens. The latter species was barely beginning to bloom, but we were assured that by Christmas the city would be blazing with its scarlet flowers. However, the sophoras, one of the few spectacular flowering genera of New Zealand, were in full bloom with their large, deep yellow papilionaceous flowers. Although we did not know it at the time, we would continue to see most of these plants throughout our three weeks in New Zealand.

That evening we drove to the top of Mt. Eden, one of the numerous extinct volcanic cones within the city. Auckland is nearly surrounded by water, for it is built on the isthmus that connects the main body of the North Island with the Northland. As we followed a portion of the waterfront, we were particularly impressed again by the magnificent of old New Zealand Christmas trees with their gnarled limbs and enormous root structures. Their thick, dark green leaves were highlighted by gray-green new growth. In one of the mud flats, Bruce pointed out a mangrove swamp. The mangrove in New Zealand is *Avicennia resinifera,* an endemic species which is supposed to reach eight meters, although it did not appear to be taller than two meters high wherever we saw it.

Our first stop next morning was at Fernglen Botanical Gardens, a family garden turned into a nature reserve and nursery by its owners, Dale and Muriel Fisher. No better introduction to New Zealand natives could have been arranged. The property has been in the hands of the Fisher family for almost 100 years, and the decision to preserve the wild area in its ravine was made early enough so that many old specimens of the native bush can be seen there. The garden contains over 600 native species. Here we saw our first Kauri *(Agathis australis)* and Rimu *(Dacrydium cupressinum)* trees. Also there were senecios, celmisias, olearias, leptospermums and innumerable ferns. There was a wealth of hebes in all their various growth forms, and there was a charming, pink-flowered native *Pimelea longiflora,* with *Daphne*-like inflorescences. We were introduced to the juvenile and adult foliage of several species of *Pseudopanax,* a member of the ivy family (Araliaceae).

Lunch at the Parnell Rose Gardens was delicious, but we learned at that point that we were in New Zealand too early to see many roses in bloom, though roses are avidly grown there and every public garden has its formal, usually extensive, rose garden.

After lunch we were met by John Braggin and Ewan Cameron from Auckland University who took us first to the Auckland Domain, where we admired the brilliant displays in the glasshouses, known in New Zealand as winter gardens. Afterward they escorted us to the Waitakere Ranges, identifying and discussing the native plants we saw en route. One that had puzzled us resembled the pampas grass that grows in Seattle gardens. This is Toetoe (*Cortaderia* sp.), another endemic. Dr. Braggin and Mr. Cameron pointed out numerous naturalized exotics including masses of *Zantedeschia aethiopica,* an attractive white arum lily. When we reached the Waitakere Ranges, we were taken to see an ancient Kauri tree whose huge unbranched trunk had smooth, gray, mottled bark and whose ragged crown was filled with epiphytic plants that we assumed to be bromeliads, though we learned much later that they were two genera of the lily family, *Astelia* and *Collospermum.* The Kauri was formerly the most prized of New Zealand's timber trees because its wood contains so much resin that it never rots. By now, large trees of this species are extremely scarce and are protected by law. Like many conifers, young trees are conical and regular in shape, and like many of the native trees of New Zealand they are very slow-growing. Everywhere we went throughout the islands, our hosts pointed out these straight, narrow young kauris and asked with pride if we had seen them yet.

At the Waitakere Ranges we also saw our first mature *Knightia excelsa* in bloom, having been

Clockwise from upper left: tr
forest plantation with typical N
cabbage tree (*Cordyline austra*
other plants; tree fern trunks u
species of *Blechnum* with fe
divaricating shrubs in the back

rn (*Cyathea* sp.); the edge of a
ealand understory; branches of a
covered with epiphytic ferns and
as a retaining wall (see p. 24); a
and sterile fronds, one of the
nd at right. Photos: J. Pirzio-Biroli

directed to it by seedlings on the forest floor. This is one of only two species of the Proteaceae native to New Zealand, although a large number of its exotic species are grown there. It is a frustrating tree for the botanist, for its inflorescences seem always to be hidden high in the branches of mature specimens.

Before departing for Rotorua next morning, we visited the Eden Garden. Established in an old quarry at the base of Mt. Eden, this private garden is landscaped with some native and many exotic plants. Our attention was particularly attracted by one of the latter: a small tree that resembled the dissected-leaved staghorn sumac except that its leaves were pink, splashed with white — a good tree to light up the woodland, as Mrs. Blackford would have said. We were told that it was *Cedrela* (formerly *Toona*) *sinensis,* or Chinese toon plant.

En route to Rotorua, we had our first in-depth view of the New Zealand countryside — the gorse, the stands of Monterey pine, the beautiful hills and emerald pastures, and the sheep. Joe's comment at the end of the day was, "I have the feeling that this is a manufactured landscape." And, although this comment applies to most of the countryside in New Zealand, the landscape does not lack for beauty. There is a sense of history in the country houses. There are occasional pockets of native bush, especially in the river valleys, and these are remarkable for the variety of textures and colors in the vegetation. The pastures, or paddocks, themselves vary from one locality to another. One of the first kinds we encountered was partitioned into neat rectangles with well-clipped *Berberis* hedges. The species of *Berberis* seems to be deciduous, and where we saw unclipped escapes on the roadsides, there were pendulous racemes of yellow flowers.

Nursery facilities at the Forest Research Institute, Rotorua. Photo: J. Pirzio-Biroli

Rotorua

There is no doubt, on approaching the lake country around Rotorua, that this is a center of the Maori culture. The white buildings with carved rust-red decorations are typical of Maori design; but beyond this, there is a sense of mystery and a brooding spirit that is emphasized by the thermal activity, for Rotorua is the center in New Zealand of the latent power residing beneath the surface of the earth. Here are warm springs, bubbling pools of mud or boiling water, and geysers which have formed multicolored silica terraces. Upon this awesome thermal area stands the Maori village of Whakarewarewa. A few miles northeast of the city is the volcano Tarawera, which last erupted in 1886, burying Maori villages and changing forever the conformations of the lakes at its base.

We spent the morning of our first day in Rotorua visiting the Forest Research Institute, the main center for forest research throughout New Zealand. Here, 400 staff members are employed in three divisions: production involving genetic selection and protection of forest plantations; forest products; and protection from erosion, particularly in the high country of the South Island. Here we saw a film on forestry practices in New Zealand, and — led by resident botanist Mr. Chris Eckroyd — toured the plantings of native vegetation, trying once more to acquaint ourselves with the characteristics of important species. We viewed the extensive nursery facilities, and walked through the Redwood Grove. The latter is a remarkable experience, for here, in a foreign country, we saw mighty specimens of our California redwoods protecting a largely native understory, including various species of tree ferns. Mr. Eckroyd had told us how to distinguish between the two genera: *Cyathea* is soft to the touch and has scales, while *Dicksonia* has coriaceous fronds and hairy stipes. The fronds of *Cyathea dealbata,* the silver tree fern, are truly silvery below — a fitting emblem of New Zealand.

Forestry in New Zealand is devoted to the reestablishment of forest in a landscape denuded of its native vegetation. Since many of the native forest trees are too slow-growing to produce harvestable timber, faster-growing exotic species have been introduced for this purpose. *Pinus radiata* is most often grown, but Douglas fir (*Pseudotsuga menziesii*) is also used. The

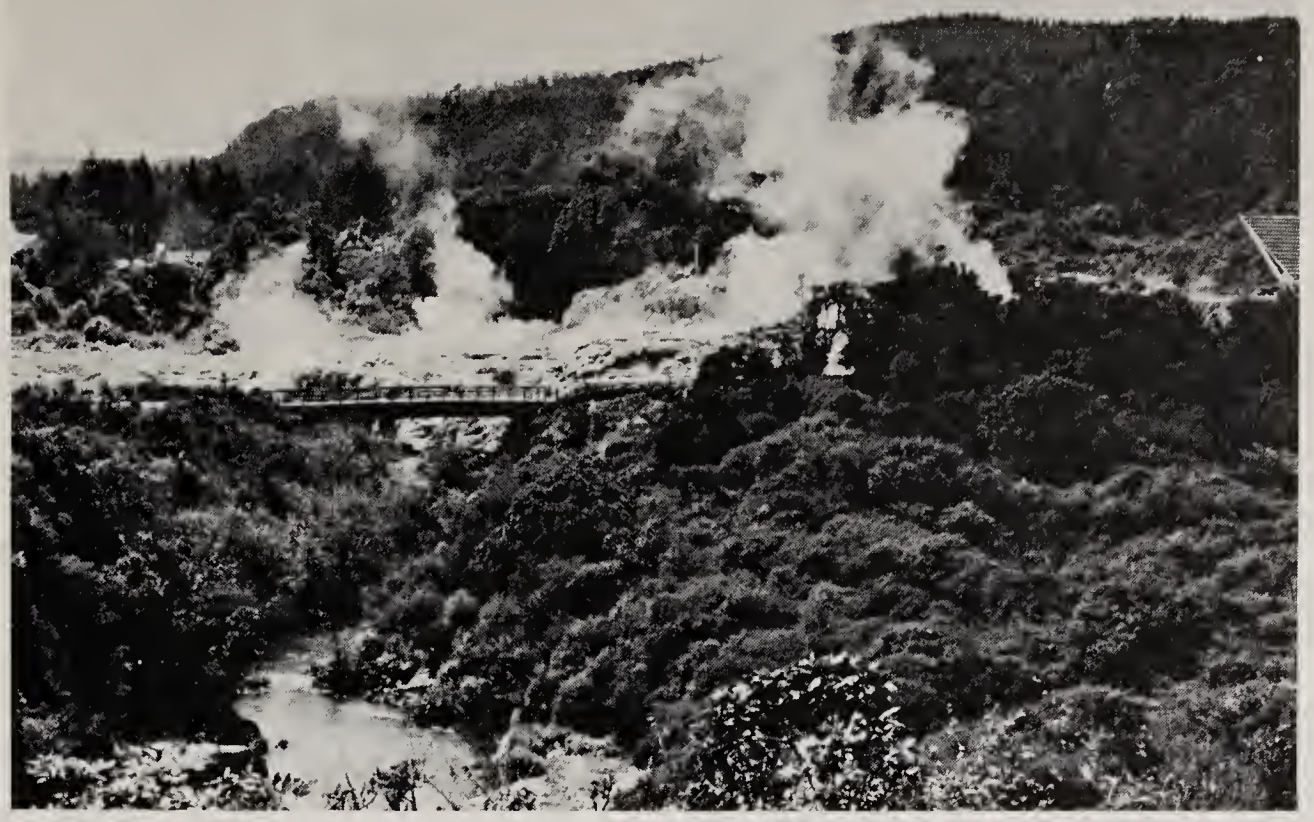


Photo: J. Pirzio-Biroli

The thermal area and Maori village, Whakarewarewa, at Rotorua.

redwoods have proven to be unusable because they grow so fast that they do not produce suitable timber. Ponderosa pine does not thrive in this climate. Joe suggested that western hemlock *(Tsuga heterophylla)* might be more successful. The use of monocultures in New Zealand is disturbing to anyone who has seen what a single introduced pest or pathogen can do under such circumstances, and because of its isolation, New Zealand is particularly vulnerable to such epidemics.

The visit to the Forest Research Institute was the highlight of our two days in Rotorua, but also we visited a number of interesting gardens and toured the lake country near Mt. Tarawera. Some of the species we saw were *Aristotelia serrata,* the wineberry; the juvenile form of *Weinmania racemosa,* which has beautiful reddish three-lobed foliage; and, along the roadside, a species of *Coriaria,* a genus which has both arborescent and herbaceous forms. Although flowers of New Zealand plants are inconspicuous for the most part, the foliage is varied and often highly colored.

At Rainbow Springs we learned that tree fern trunks are frequently used in New Zealand, lined up side-by-side, as fences and even retaining walls. When they are fresh, they may sprout and begin to grow, but they also can perform as host for various epiphytes whose spores or seeds might become embedded in their bark.

En Route to New Plymouth

En route to New Plymouth we stopped to visit a remarkable garden, the Waipahihi Botanical Reserve, which was established only 14 years ago on 85 acres of second-growth scrubland by an enterprising group of less than 35 gardeners. Although no tour had been arranged for us, we were soon gathered up and deposited in areas of particular interest by Mrs. Freda Cumming, one of the founding members and a regular volunteer, whose day it was to host the garden. Although most of the trees are relatively young, there are an excellent alpine garden featuring New Zealand plants, a collection of over 2000 rhododedrons and azaleas, and a well-labeled native walk. In fact, the labeling everywhere was very well conceived and as complete as possible. An interesting feature of the native plantings was the manner in which species were grouped with their varieties, and various species of one genus were planted together so that one could better understand the differences between them.

The road from Lake Taupo wound through the Awakino Gorge, toward the Tasman Sea. In this rain forest we saw the native palm, the endemic species *Rhopalostylis sapida,* which is the only palm native to New Zealand proper, and which grows at the southernmost limits for the family. There was a wealth of tree ferns seen at their best as one looked down upon them, and the trees were draped with epiphytes. Here we were impressed again with the textures and tones of green in the native bush, and many photographers among us regretted the impossibility of stopping on this narrow road.

Suddenly we reached the sea and the tiny fishing village of Awakino, with its wide beaches of black sand and fishermen netting whitebait along the shore of an inlet. As we approached New Plymouth, Mount Egmont appeared before us in a cloudless sky, glowing in the late afternoon sun. Bruce told us that we were lucky to have seen it, for often it is hidden by cloud cover.

(*To be continued.*)

Overlapping leaflets of *Mahonia aquifolium* 'Madison Park'. Photo: G. Pirzio-Biroli

Discoveries and Introductions

*B. LEROY DAVIDSON**

American nurseries and gardens are far from impoverished; heaven knows there is a wealth of things suited to any and all growing conditions, much still untried by any real enthusiast whatever his station, his taste and inclination. But how is one to judge from the blazing word and stunning photograph whether something "new" is really worthy or whether it might prove acclimatable once it has become available. Undaunted, the dreamer goes for it, not merely from stubbornness, but because he is a curious person, the insatiable romantic or "collector" among gardeners.

And so, admitting to being among those seemingly dissatisfied souls, I've been party to bringing back over the years quite a number of untried things and to passing them around as a means of obtaining from several viewpoints an assay of their intrinsic values. One of the side benefits of such has been making the acquaintances of similarly smitten enthusiasts, and inevitably they are keen to share both plants and experiences. While not all these so-called "finds" are original discoveries, I have in some way been instrumental in the games of searching and sharing, in having grown and shared a number of woody subjects in addition to the several mentioned in the *Arboretum Bulletin* (Vol. 39, No. 4, 1976).

The great arboreta and other collections are replete with splendid trees and shrubs, but by far most of them suited only to larger properties. This dreamer's eye continuously envisions something "just as good" but scaled down to a proportion useful on the small property, and among our western trees and shrubs there are several of possible distinction.

Mahonia aquifolium *'Madison Park'*

It is now nearly thirty years since I made the first of these selections from a seedlot of Oregon grape that had been planted some years before. As has been mentioned*, there are several variants of this species in the nursery trade, most of them smaller growing forms; this is large, and its beauty and usefulness lie in the broadly overlapping leaflets. Although I now have several plants, it has not been extensively propagated nor introduced.

Juniperus horizontalis *'Big Sky'*

The broadly undulating scarps and plains against the steeply uplifted limestone east face of the Rocky Mountains in north central Montana are darkly splotched with broad patches of what

*We are pleased to have another contribution from Mr. Davidson. For additional details on some of his introductions, the reader is referred to his article, "Collecting a Landscape" in the *Arboretum Bulletin,* Vol. 39, No. 4 (1976).

is locally known as ground cedar. A casual walk or drive amongst them quickly reveals a great diversity of color and texture and habit here in the westernmost colonies of the species, and, as it is far from being palatable livestock browse, there is no objection from the cattlemen to taking all you want; in fact some of them have bulldozed and seeded pasture grasses. From amongst a couple of small truckloads, which I removed to eastern Washington as a ground-covering brocade about a watered lawn with post-and-rail enclosure, one single fine-textured and wide-spread blue-green specimen has been singled out as individual enough to be called by name, and the popular name for the Big Sky State of Montana identifies it. I envision sometime a lawn of it; a couple of plants in my Bellevue (Washington) garden were well on the way to that effect when they were shaded badly by a covering pine. Mr. Roy Elliott, one of the most noted of today's British plantsmen, stated this to be the best juniper he had known. It is not commercially introduced up to this time. My search for a coppery one fell short and that which I called temporarily 'Pondera Copper' failed, when away from the aridity of Pondera County, to color at all.

Holodiscus boursieri *'Tenaya'**

While marooned in the Tioga Pass moorlands east of Yosemite by an early snowstorm, I came onto this bushlet one November morning, pushing out of a granite seam to all of a foot and a half and showing evidence of having flowered profusely. Brought home, it has grown to twice the height but remains a tidy subject, whereas our own more northern species are tall and leggy flippers in the watered landscape. Though the panicles of my collected plant are far smaller, they are four times the number, set closely and covering the small wedge-shaped leaves, giving a solid but ethereal effect like old Irish linen cutwork. New growth, rather than high up on old canes, springs from the base and consists of dark arrow-shafts, forming a neat and shapely bush. A small propagule inserted in a bored tufa has produced a froth of flower entirely shrouding the nine-inch bush for the John Watsons in England.

Acer circinatum *'Aldara'* and Acer glabrum *'Eldorado'*

Witches' brooms, those strangely dense, twiggy abnormalities, have been found several times in vine maple and occasionally propagated. The one I have called 'Aldara', for its place of origin near Issaquah, Washington, appears to be of fairly rapid growth, although it has not been possible to date to make any actual comparisons between any of its clones. A grafted plant of the one found by Alleyne Cook in Stanley Park, Vancouver, BC has become locally famous as I passed it along to Connie Raphael, noted bonsai artist. Another graft of the same age is illustrated in Vertrees' book of maples as growing on the rock garden of the University of British Columbia (and there named 'Little Gem') while a third is in Mr. Cook's North Vancouver garden. Any and all of these various brooms, grafted or on their own roots, are certain to become highly regarded as fine smaller versions of a splendid species of maple.

The tripartite *Acer glabrum* mentioned previously* was found twice near Boulder, Colorado, and once in the Idaho panhandle (the latter is the variety *douglasii).* That illustrated in 1976 was smallest of leaf; it was from the Colorado Front Range, in Eldorado Canyon, now included in Eldorado Springs State Park. There it was a dense multi-branched, large shrub, perhaps twelve feet in height by twenty feet, and colored in early October a softly glowing buff-yellow; but the delicacy of the leaf canopy puts it within the elite of the finest of maples. It is yet untried in Puget Sound conditions, and one might speculate that, since the forms of *A. glabrum* var. *douglasii* as they occur on the San Juan Islands are tall and massive, yet still graceful maples, this might prove to develop interestingly.

Some Irises of the West

My personal interests are not confined to woody subjects; in fact they have dealt with several flowering plants that are somewhat lesser than shrubs, notably irises — whose pursuit, incidentally, led to the majority of the other finds, and then to that shrubby group, the *Dasanthera* penstemons. Commencing in 1943, field study of *Iris missouriensis* in thirteen of our western states and two Canadian provinces led to a rather large number of transplants, from which seed was sent to several exchanges as "Hawksbluff Strain", and the albino called 'White Canary' has been listed.

For many springs an annual trek in the forested mountains of northern California, western Oregon

and Washington, yielded many colorful variations of the many species of the *Californicae* group of irises, and a small-scale breeding program between some of them produced what may be better garden plants than are the species themselves, at least in watered gardens. One was 'Lemonade Springs', a bright lemon *innominata-douglasiana* hybrid of the greatest vigor. 'Hinges of Hades' was a hot, bronze-red with cadmium orange spot, from an inbred *innominata* hybrid line. While investigating the rapidly disappearing *Iris purdyi* in redwood country, I was fortunate to collect, unbeknownst and out of flower, what proved to be a rather exceptional amethyst-colored one, a hybrid with *douglasiana* called 'Mendocino Morn'. From a yet undisturbed colony of true *I. purdyi,* now a rarity as a result of its being outcrossed in the wild to the invasive *I. macrosiphon* as the timber cover is disturbed, I got an especially fine selection, 'Memoria Elwood', named for a late friend. Dr. Molseed and I each on his own had discovered the identical colony.

Seed from this assemblage has fallen and germinated to cover a cooler eastern, semishaded garden slope with many a chance seedling, and the results have been offered in seed exchanges as the "Rosedown Strain". As such it has been successfully flowered, with a bit of special preparation and protection, in places where irises of this ilk had never been possible — New England, Pennsylvania, Oklahoma, for example. Prior garden strains essentially had been based on *innominata* and *douglasiana,* and the heavy concentration of *innominata* and *tenax* would account for this success. As *douglasiana* in its natural distribution seems limited in the north to the shrouding summer fog belt on Pacific shorelands, it is not so hardy as is the inland *tenax.*

The iris work commenced as a field study of the described species, which led to an ecological research to ascertain the factors that confined a given taxon to its given range. In turn this led to plotting where these limitations might allow hybrids to occur and more often than not we found them; very often they were of some special interest, particularly in that they offered patterns and colors not known to any so-called pure species in its natural occurrence.

Penstemon *subgenus* Dasanthera

The year 1947 saw the commencement of a similar field study not yet ended, the investigation of the shrubby species of *Dasanthera* penstemons of western North America, occurring from Vancouver Island and the Rocky Mountains of Alberta, in Canada, to the south as far as Wyoming and Utah and in the Cascade-Sierra as far as Yosemite (a pursuit that had led to the *Holodiscus).* A vast number of cuttings representative of the populations observed (25 individual plants from each colony — both bonafide species and the hybrid colonies), were plotted and found, as had been the irises. It was not long of course before the nursery area set aside for them was overflowing, and for some quite unaccountable reason they have never prospered quite so well since. From these were chosen some few of exceptional garden merit and, as with the irises, it was most often among the hybrids that the unique ones were selected.

'Breitenbush Blue' from an Oregon hybrid swarm between *Penstemon davidsonii* and *P. cardwellii,* flowered in the plot nearer azure than anything seen flowering up to that time. Further, it was an extremely tidy mat-forming plant that reflowered to a degree in late summer. Rather similar, though with a lightly glaucous leaf and pink flower, also reflowering, was a plant grown from Carl English seed collected in the Trinity Alps. Though recorded as *P. newberryi,* the Englishes were later to concede that it really belonged to what Miss Eastwood published as the subspecies *berryi.*

It is quite true that these shrubby penstemons are not for most coastal gardens, but grown away from the humidity they are among the finest of small flowering shrubs. A really good, low-growing albino, *Penstemon cardwellii,* was given me by Dave Every, one he had found on Mt. St. Helens pumice in the course of his doctoral investigation of the *Dasanthera.* This is now historic, or course, and I am pleased to have passed it along in turn so that it is now available to gardeners, a better proportioned plant, in flower and leaf, than formerly grown white *P. cardwellii.* There were others, some not really so good in the long-run, though 'Keechelus Blush', from the vast Yakima River headwaters swarm between *fruticosus* and *rupicola,* was a most sumptuous pink with clean sage-green leafage. The plant known in gardens as 'Holly' had come to me as a nursery plant called, obviously in error, *P. newberryi,* which should have had a red tubular flower. This broad-bugled lilac-flowering plant showed by its

incised and crisped, crystalline leaf to be *P. fruticosus* var. *serratus,* and I later was to find many similar ones in the high places about Hells Canyon of the Snake River, in three states as a matter of fact, although none was quite so good in leaf as 'Holly', which now is widely grown and admired.

From Foreign Places

It is now nearly twelve years since my first visit to Japan, enough of an interval that some of the things brought back can be evaluated. Brian Mulligan has been so kind as to have published on the gold-spotted *Weigela maximowiczii (Arboretum Bulletin* Vol. 39, No. 3, 1976). This unusual yellow-flowered species is not all that outstanding really, and is known in the American nursery trade as elsewhere; however it is the brilliant spotting of its flowers that sets this one apart as "better". I had selected a small seedling from beneath such a spotted bush in flower, chancing that it might also be attractively marked. This is a flower that floral artists might perhaps most appreciate for its subtlety.

From a small stall in the city of Shizuoka I purchased two small rooted cuttings of a pale yellow-green *Chamaecyparis pisifera* 'Plumosa', and by now each has grown to only pie-size, ten inches across and barely six inches high. It might be questioned if the dwarf conifer ranks need another member, but as this was compared to others in English collections it appeared to be quite distinct and I have consequently named it 'Lime Pie'. It is finely textured and rather than losing its soft color in summer it becomes more distinctly lime-green and thus quite unlike any known before.

It is one of the unwritten Japanese customs that a plant admired must be shared, and thus I came into possession of the prostrate form of *Deutzia gracilis* growing on the rock garden of the Nikko Botanic Garden, a gift of Dr. Kubota, the curator; I was soon to see a plant named 'Nikko' in a British nursery list, though I was uncertain if it was the same. It is; and the story is that at the same time my friend Jack Craig had also been given it. He had sent it off to New Zealand where it had been propagated to become a much-favored rock garden subject, and from there it had gone to England. Both Jack and I had referred to it by the name 'Nikko' — although beyond the *Romaji* spelling "chabo" (dwarf) it had not been previously designated. Thus it was introduced here and offered for sale from my own importation even before it was known elsewhere. Typical white flowers are profusely borne in season on a stoloniferous, wide-spreading, matted little bush, very handsome on rockwork.

Also seen on the Nikko rock garden was a lovely little grass, *Melica nutans,* but I was not bold enough to admire it aloud and had to wait eight years before I saw it again, this time at Kew. Mr. Halliwell was kind enough to let me have some pieces of it — it turns out to be an English native known as "mountain melic". It is a green tufted grass, not unusual until the short spikes develop to look like miniature green-flowered ixias and remaining handsome through the season — all of eight inches high, a true aristocrat among small non-invasive grasses.

The second visit to Japan in the company of Stephen Doonan led us also to Taiwan; we were studying members of the much-sought family of subshrubs, Diapensiaceae, the *Shortia* and *Schizocodon* and *Diapensia* itself. But before this, it had been my fortunate accident, a whim of Japanese weather, that had led to the finding of one of the rarest and loveliest of this family of

Left: *Schizocodon ilicifolium* var. *intercendens*. Right: Two mature plants of *Chamaecyparis pisifera* 'Lime Pie' growing in the corner of a concrete trough.
Photo: G. Pirzio-Biroli.

treasures. Jack and Ginko Craig had planned to show me one of the high-mountain plant refuges in central Honshu. It was typhoon season on the coast and one of the storms moved inland to prevent us from reaching our destination; so we took refuge in the spa-village of Sumata-kyo and early next morning set out to climb the steep trail at the edge of the village, which seemed to promise at least a spendid view before the train moved out. We found that the hiking trail was being rebuilt, and also that the north face of this precipice was a solid mat of *Schizocodon!* Only hours earlier workmen had torn out a decaying stump into which an enormous wad of the plant had rooted; it lay unwilted in the wasted grit and rubble and moss, and thereupon was stuffed into a large plastic bag. It was July, long past flowering season for the plant, and elongated scapes bore fat seed capsules, none of which showed any taint of reddish color; upon enquiring later of a lady on the train if it was perhaps white-flowered, we were assured that it was. We had been mooning over the exquisite pictures of this, *Schizocodon ilicifolius* var. *intercedens,* in a recent new publication and had stumbled onto it quite by happenstance! Sent home, the plant flourished and was shared. The seed ripened and Doonan succeeded in growing plants from it.

We were now seeking cutting material and seed of it again, as well as of its relatives. The pursuit netted a wealth of material and took us to Taiwan where we all but got an entirely new species of *Shortia,* but plans again were at the whim of weather; rain destroyed the logging railway, and we were evacuated only a day short of our goal. Thus our hope of introducing an entirely new *Shortia* must wait, but in the meantime the *Schizocodon* has been widely propagated and from here introduced to Britain.

I am not at all certain of the origin of the neat little *Hydrangea* 'Pia' which came to me from Robinson's Hardy Plants of Crockenhill, Swanley, Kent, and which they had introduced to British horticulture from Denmark and beyond that knew nothing. A slow and hungry little thing, it does not run away with itself in exuberance, making a dwarf, branching subject smothered in due time with rose-colored flower heads of the *hortensis* persuasion, to which it appears allied. The color holds, deepening to a dark raspberry hue as autumn approaches.

Bergenias have been a crusade of an entirely different nature. What we have in our gardens and nurseries have come from European sources, most of them imposters of hybrid nature going by the names of the Asian species, and most of them large and coarse. Our so-called *"B. stracheyi"* is in reality the old Irish hybrid *smithii* (figured in no less a prominent place as the *Botanical Magazine* by the incorrect name) and the proper *B. stracheyi* in several forms is now being propagated from seed originating in the western Himalaya. It is a hardy and handsome small plant whose leaves turn to lovely crimson and rust winter hues and whose rose-colored flowers are not so precocious and therefore miss the freezing weather. There are others — some natural plants, others which are smaller hybrids — and about a dozen of them are currently being evaluated. Bergenias have lost in favor as garden plants, apparently through their identities having become so muddled. The color range is from white and blush or apple-blossom, to rose and rosy cerise.

A Wealth of Hostas

I must acknowledge the assistance of Jack Craig in what is likely the cointroduction of several hostas, some of them so rare they are collector's treasures even in Japan. Ohwi stated that such genera as *Hosta,* being so complex, could not possibly be treated in his *Flora of Japan,* and thus some of these microspecies remain little known and little sought. Several of these historically significant rarities have gone from here to Kew. We have made several excursions to find the misinterpreted *Hosta longipes,* with autumnal flowers on a small though not miniature plant, which in the monsoon summer we found clinging to bare rock exactly as do the epiphytic orchids. The Hosta Society has acknowledged our introduction of the true species, for what previously had been known here and elsewhere by the name was an imposter flowering in early summer. Also introduced were a number of miniature horticultural forms whose identities are not easily sorted out, and to which only their *Romaji* names can be applied; they seem to have been passed down in Japanese horticulture for generations, in most cases their origins now unknown, which does not diminish their individualities although it definitely limits their appeal except to those who see them; and all those who see them want them. To the smallest of these I have given the name 'Suzuki Fingernail' for

the reason that it is descriptive of the size of the leaf blade; it came from the famous alpine nursery of Mr. Suzuki of Kanazawa, Yokohama. A similar one a little larger is now 'Suzuki Toenail'; both have short spikes of a few typical lilac flowers in July and are shortly spreading to matted colonies by stoloniferous rhizomes.

Hostas have been of major interest here for half my lifetime and it would seem that there could be no further room or need for more of them. But by far the bluest leaf is possessed by a small hybrid brought from England last autumn. It was raised by Eric Smith who has done some rather extensive controlled breeding with this most magnificent group of summer foliage plants. Soft lilac flowers are of great delicacy on this rather vigorous, glaucous plant and I am hopeful that in time it might be accepted as among the "best". It is called 'Dorset Blue'.

The English publication *Gardeners Chronicle* in 1881 published "A tribute to botanical explorers . . . of all the deadly occupations this is surely the most fatal." My own travels have not been nearly so fearsome as this suggests, not so dangerous nor as yet, so fatal. Hopefully there is time for many another excursion, time for seeking, time for sharing.

Arboretum Notes and News

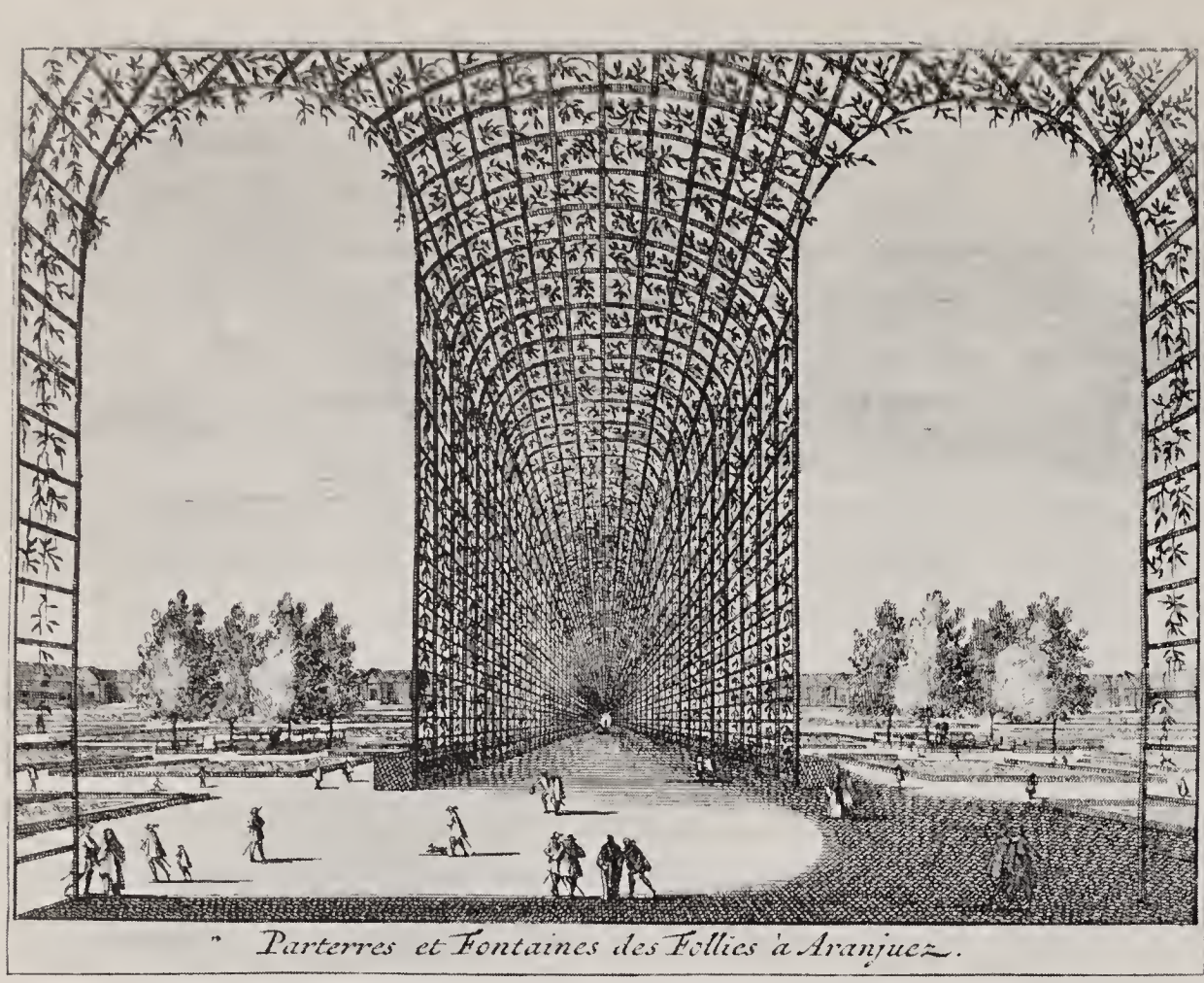
Several large steps toward implementing the Master Plan Update for the Arboretum in Washington Park occurred this summer and autumn. Perhaps the most dramatic was the filling of the so-called "pit", that area at the north end of the Arboretum which was excavated to be part of the defunct R.H. Thomson expressway and later was used as a Pea Patch. Plans for this area were drawn by the landscape-architect firm of Peterson and Buckingham, changing the depression into a rolling conifer meadow. Filling began in late summer and is now completed except for some recontouring of the shape of the small hills and valleys. The fill material is reasonably quick-draining gray sand, not blue clay. Planting will begin once turf has been established and will feature mixed conifers and deciduous trees.

Less obvious, but in many ways of more far-reaching consequences, is the progress made on the replacement of the irrigation system. The engineering plans will have been prepared and accepted, and by the time of publication the contract for actual construction will have been let. Work on the project should be underway by the first of 1981 if not before. This replacement is badly needed because the original system has deteriorated to the point that it is no longer reliable and needs constant repair. Funding is from the Arboretum Trust Fund.

The *Bulletin's* loss is the Arboretum's gain! Jan Pirzio-Biroli has accepted a position on the Arboretum staff as Naturalist and Volunteer Coordinator. She will be responsible for organizing the many volunteer efforts which help keep the Arboretum running. In addition, she will be charged with the production of informational pamphlets and brochures explaining the Arboretum to the public. As if this weren't enough, she also will be quarter-time secretary to the Arboretum staff.

This change came about when the secretary's position became vacant and it was decided that the many duties of that person could be divided. With the assistance of the Unit Council, volunteers were found who will act as receptionists in the office; budget activities will be transferred to the Center for Urban Horticulture and Jan will deal with the remainder. The arrangement has been working very well during the first several weeks of trial and we have high hopes that this auspicious start will continue into the future.

One other personnel change occurred this fall when Mr. James Thomas, Gardener III, was assigned to be in charge of the Seattle Park and Recreation Department staff in the Arboretum. *J.A.W.*



An example of distorted perspective to increase the appearance of distance. From: *Beschryving van Spanjen en Portugal,* by Alvarez de Colmenar. Pieter vander Aa, Leyden, 1707. Courtesy of the Rare Book and Research Materials Collection, Special Collections, UW Libraries.

Aspects of Landscape Perception

*ELIZABETH RIVERS**

With increased concern over environmental problems has come a realization that an understanding of landscape perception is important, that an awareness of factors relating to the way the landscape is perceived may result in improved landscape quality. The following is an investigation into some aspects of landscape perception and how it relates to plant materials.

Although all of the senses contribute to one's ability to perceive, the eye is the primary link between reality and intellect, even though vision is frequently imperfect. Retinal images are inverted; refractive distortion occurs because the object viewed is usually not exactly in line with the central axis of the lens of the eye; inaccuracy in determining sizes at a distance and the ability of the human eye to see only a fraction of the color spectrum are both due to optical limitations.

One feature of vision that is most important when considering landscape perception is the tendency of the eye to see things in a relative way. Light foliage viewed against dark foliage seems lighter than when viewed alone, whereas a gradual change in value will lessen the appearance of contrast. Plant textures also are viewed relatively. A fine-textured plant may become a coarse-textured one in a different context. Plant textures can be arranged so that the brain is deceived. Coarse textures in the foreground, becoming more fine toward the background, will give a sense of greater depth.

Illusion, primarily as it relates to perspective, plays an important role in landscape perception. While the eye is the sole source of some illusions because of its structure, most illusions are generated by the intellect. Information transmitted to the brain by the optic nerves is decoded and combined with data acquired through the other senses and then interpreted in terms of past experience. The cues used to determine perspective are learned, and if they are misinterpreted, illusions result. Landscape elements can contribute to this misinterpretation. Converging lines and angles can cause perspective illusions; for example, angles of greater than ninety degrees give the appearance of greater distance. Deeper perspective also may be suggested by decreasing size of known objects. If errors are made in judgment of size, however, corresponding errors in determining distance may result.

Another interesting illusion occurs because of the tendency of the eye to favor vertical over horizontal dimensions; that is, things tend to seem taller than they really are. A tree does not appear to be as large when it is lying on the ground as when it is standing.

The eye will also pick up the rhythm of a visual pattern; for example, it will be attracted by a gap in a line of otherwise equally spaced trees. Then the brain will "fill in" the missing element; it will sup-

*Elizabeth Rivers wrote this article as a term paper for Professor Patricia Gutter's class in Landscape Architecture. Drawings on succeeding pages are by the author.

ply the missing tree or complete enclosures from partial ones. This striving for visual completeness was Goethe's explanation of after-images of colors: ". . . we find, in walking through meadows, where we see scarcely anything but green, the stems of trees and the roads often gleam with a reddish hue" (6, p. 86)[1]. He felt that the eye, when viewing a color, "completed" the color wheel by visualizing the complement of the viewed color in an after-image.

Color is light of a particular wavelength acting on the retina. It attracts the eye more than any other element in the landscape. A color and its complement, when placed next to each other, will compete visually for the eye's attention resulting in a lessening of the impact of both colors. When transmitted to the brain, color affects perspective and scale — objects in bright, warm colors appear to be larger and nearer while those in dark, cool colors seem to be smaller and more distant. Color influences textural decisions — pastels seem fine textured, browns seem more coarse. Emotion also is affected — warm colors excite, cool colors soothe. As light-points of different color strike the eye, they are fused. This causes them to overlap, more so with increasing distance, so that color in nature — the autumn leaves of a tree, trees on a hill or flowers in a field — tend to mix together and blend into single colors.

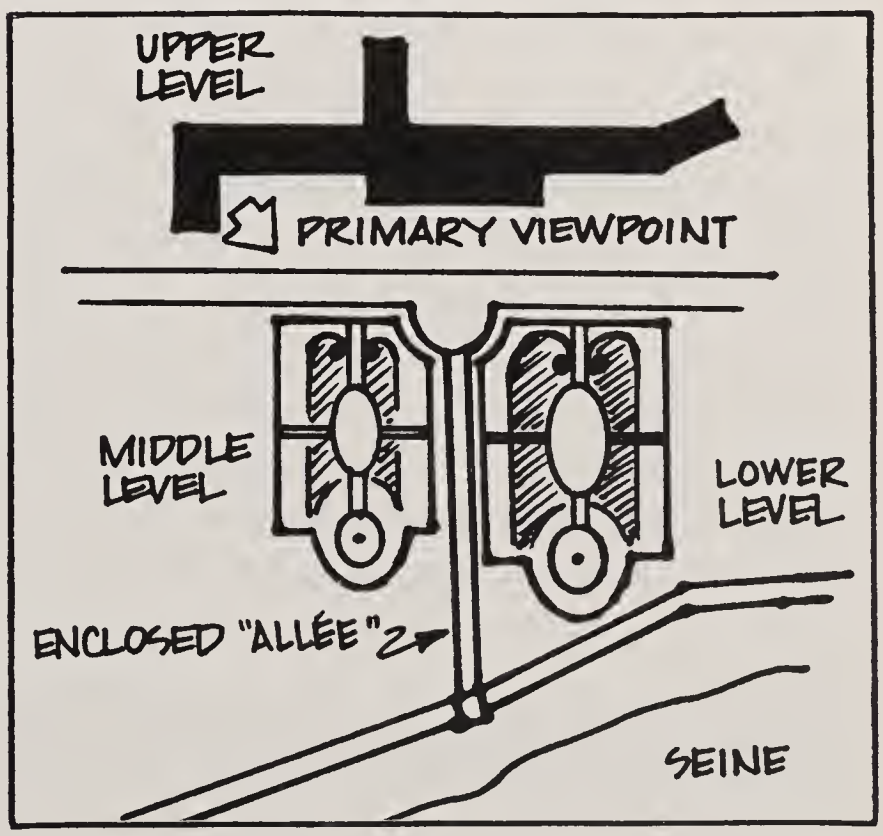
Atmosphere, another important factor in landscape perception, also may influence color as seen from a distance. Atmospheric pressure, moisture and particulate matter in the atmosphere such as smoke and dust intervene and influence color values. As the distance from the viewed landscape increases, the intervening atmosphere causes colors to become more blue or gray. If inversions occur, with a layer of dense air overlaying one of less density, light can be refracted and cause additional landscape illusions. In rainy or misty weather, when light cannot penetrate the atmosphere and scatters instead, the landscape and elements of it seem larger than normal.

Although systematic research into landscape perception is relatively recent, that does not imply a prior lack of understanding, for the eye, the brain, and the atmosphere have been used by shapers of the landscape throughout time. A knowledge of what has been done in the past is helpful for a better understanding of the concepts presented above. Some of these techniques may be adapted for today's landscape while an awareness of past mistakes can prevent future errors. A few representative examples from history follow.

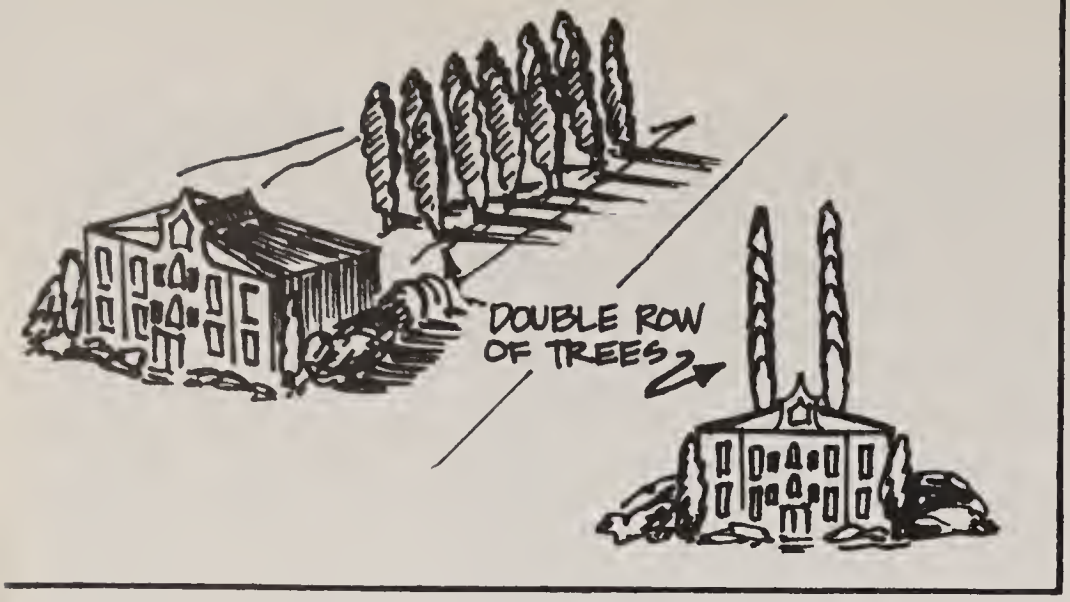
The gradual evolution of landscape design in the East resulted in a basic concept — the intimacy of man within the context of nature idealized. Understanding of Japanese and Chinese gardens depends heavily on understanding their inherent symbolism. Although some gardens "borrowed scenery" in order to extend their boundaries, others had a deliberately closed vista. In a way, the entire garden was based on illusion and although the vista was contained, there was a striving for a feeling of infiniteness. Oriental gardens represented, on a small scale, all the grand design of nature. The scale, in fact, was at times smaller than human. This reduction of scale was intended to stimulate the mind rather than to deceive the eye. A Chinese traveller in England "was amazed that any civilised person should want a 'mown and bordered lawn' which he pointed out, 'while no doubt pleasing to a cow, could hardly engage the intellect of a human being' " (4, p. 18).

In the West, Italian Renaissance humanists also were concerned with stimulating man's mind. They framed views of the bluish hills of Tuscany and provided whole gardens for the purpose of scholarly interchange. They extended the

Parterres of different dimensions and on different levels designed to look equal from a specific viewpoint. The effect is made less apparent by the enclosed shrubbery along the central axis. (Conflans, France).



[1]Numbers in parentheses refer to numbered references at the end of the article.



A double row of trees arranged upwards on a slope to appear as two abnormally tall trees. (Villa Dona Dalle Rose, Italy).

rooms of their houses out into the landscape, creating outdoor "garden rooms", and then painted frescoes depicting the land surrounding their villas on the walls inside the buildings. False canopies were erected indoors to provide "shade" from the imaginary sun.

The warping of perception was practiced by the French, most notably by Andre Le Notre[2], who studied works concerned with perspective and optics. He used many visual "tricks" in order to add interest to his gardens which were otherwise rather cold and formal in design. One such device, used at Versailles (and also in Italy at Villa Barbarigo), was two straight rows of trees which would be perceived from a distance as two single, gigantic trees. He also used optical illusions to make visual corrections that resulted in greater regularity in the overall design of the garden. Two parterres, for example, were of different actual size and on different levels, but when viewed from a raised vantage point some distance away they appeared to be level and of equal size.

The English had a preoccupation with making parks and gardens appear larger than they really were. This was achieved primarily through optical illusions designed to distort perspective. In the eighteenth century, William Kent used converging rows of trees which were spaced wide apart at the near end and increasingly closer together toward the far end. Other devices such as progressively shorter trees also were used. Humphry Repton took advantage of the principle of objects of a known size as a perspective cue; he introduced undersized cattle and ponies grazing in the park to give a feeling of greater distance. The problem with these devices, of course, was that they could only be viewed effectively from one direction.

[2]"Le Notre" is spelled in English with a circumflex over the "o" to denote a missing "s". Unfortunately our type face does not contain diacritical marks.

Another element of Eighteenth Century design was the "ha-ha". This was a ditch and sunken wall surrounding the manor house and nearby lawn, designed to keep cattle away from the house. It acted as a physical barrier, but not a visual one. The lawn close to the house was mown by a scythe and was of relatively fine texture compared to the coarser texture of the area grazed by the cattle. The overall effect, however, when viewed from the house, was of a vast lawn of continuous evenness. More recently in England Gertrude Jekyll used color to convey a feeling of greater distance. She exploited the concepts that blue implies greater distance and that warm colors make objects seem nearer by arranging floral colors accordingly.

These visual games are amusing to us now, but it must be understood that these illusionists all had basically the same intent. They wanted the landscape to catch the eye of the viewer, hold it and cause it to affect the mind in a positive way.

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The "ha-ha" kept animals away and provided a view from the house uninterrupted by fences or walls. The detail at lower right is a reverse view of the ditch and fence. (Stowe, England).

The broad leaves and bluish new growth of *Sequoia sempervirens* 'Cantab'. Photo: G. Pirzio-Biroli

Two Forms of the Cambridge Redwood

B. LEROY DAVIDSON

Mr. Roy Lancaster's name CANTAB for the erect-growing, broad-needled *Sequoia sempervirens*[1] was no surprise to me, since that was the label my plant bore as it came to me, a small pot-grown cutting, from Donald Stryker in 1961. Publication of the name clarifies a point of which I was unsure, for when I obtained it, I understood that this was the prostrate redwood that had been found as a branch sport or witches' broom at Cambridge. Material was propagated under the name 'Cantab' (although the name was never published), and when Graham Thomas showed his plant it was given the Award of Merit (1953) as 'Nana Pendula', although it is now called 'Prostrata' — neither name being appropriate to my plant.

It was shifted up several sizes of pot, and when it had grown too large to be maintained as a container subject, it was put into the open ground with the expectation that it would undulate down a north-facing slope. I followed instructions rigidly, nipping out all the erect growth and taking propagation material only from the pendent, outermost ends. When rooted into its new situation it reacted in its own surprising manner by throwing up simultaneously several striking strong poles of trunks, so handsome I left them. When a few winters afterward these were arced to the ground in an exceptional, wet snowfall, they were salvaged — two of them — by tying to a strong post, the others removed. At this writing this dual-trunked tree has reached to 18 feet with the secondary trunk to 15 feet. It has remained uninjured through the cold[2] of two recent winters. The new growth is rather of a bluish cast, and the especially broad needles contribute markedly to its distinctiveness.

In his article, Mr. Lancaster pointed out that the unpublished name CANTAB was available and appropriate to designation of the erect form of this striking tree. It should become better known as a slow-growing coniferous specimen.

Note: One plant of 'Prostrata' at the Arboretum, received from Mr. and Mrs. Page Ballard of Issaquah in September 1969 and planted in January 1973 when 18 inches high and 30 inches wide, is now (September 1980) four feet high and nine feet in width. Occasional vigorous upright shoots have been removed. A tree of 'Cantab', received under that name from the Strybing Arboretum, San Francisco in April 1960, originally also from Stryker's propagation, and planted out 11 years later, is now 25 feet tall and growing vigorously. *B.O.M.*

[1]Lancaster, Roy. January 1979. *Sequoia sempervirens* — a new cultivar. The Garden (Journal of the RHS) 104(1):28-30.

[2]Temperatures in this low-lying valley north of Factoria, WA are consistently several degrees lower than Arboretum recordings.

Dean Marckworth in an informal moment, February 1958.
Photo: J.A. Witt

Gordon D. Marckworth

1895-1980

The death on August 25, 1980 of Gordon D. Marckworth, Dean Emeritus of the College of Forest Resources, University of Washington and Editor Emeritus of the *Arboretum Bulletin,* was announced in the Fall issue of this *Bulletin.* No brief statement such as this could hope to cover the 85 years of a life dedicated to education in natural resources and to informing the public in matters pertaining to the use of plant resources by man in urban and forest environments; but I shall attempt to review the highlights of his outstanding career.

Dean Marckworth was born near Cincinnati, Ohio in 1895 and according to emeritus Professor Frank Brockman, anyone who could survive in Cincinnati in those days had to be tough. As was the case with many distinguished Seattleites, Dean Marckworth's early career was centered in the east and south. His education consisted of undergraduate training at Ohio State University, a masters degree from Yale, and additional studies at the University of Edinburgh in Scotland.

After military service in World War I, he held various forestry positions in the east and south which led to academic assignments as head of the Forestry Departments of Louisiana State University and the University of Georgia. He left Georgia in 1939 to take a Forestry Professorship at the University of Washington and became Dean of the College of Forestry in 1945.

Gordon Marckworth's entry into the Northwest forestry and plant culture scene came at a very opportune time. The expansion in student numbers at the University of Washington after the second world war called for qualities of leadership and innovation. He provided the necessary ingredients to make the College of Forest Resources a major institution in its field during his tenure as Dean over the 20 years he held that office. His major accomplishments were:

1. The expansion and upgrading of the College library which has now developed into one of the principal forestry libraries on the west coast.
2. The expansion and advancement of the graduate training program. During his tenure the program went from a handful of students to over 75 and his groundwork was so well established that now more than 250 students from all parts of the world receive advanced training.
3. The provision of a scholarship and fellowship base at the College. Numbers of fellowships went from one at the beginning of his tenure to more than 25 at the

end and at the present time, the College is able to distribute about $88,000 annually.

4. Development of the teaching and research base at the Charles Lathrop Pack School forest through acquistion of more land and better facilities.
5. Organization of an active forestry alumni association, since one did not exist at the time he became Dean.
6. Strengthening of relationships between the College, the forest industry, and federal and state land agencies.

In carrying out these programs, Dean Marckworth became well known throughout the state, nation and the world as a leader in forestry. It was during his tenure as Dean that the University hosted the World Forestry Congress. He was the recipient of many prestigious awards and titles and served on innumerable committees and boards in his professional field as well as in general public service and civic organizations. Many of the developments in forest-land administration and allocation which we have today were the result of his wise counsel and dedicated work. I was employed as a faculty member by Dean Marckworth when he looked ahead and saw the need to develop soil and plant nutrition programs at the College. He took a close personal interest in these programs and helped insure that they got off to a good start. This enabled me to establish a close relationship with him and I found him to be a truly fine gentleman at all times who possessed the ability and capacity to guide the College through the years of some of its greatest development and some of the most trying times.

Dean Marckworth also had a personal interest in the Washington Park Arboretum and worked throughout his career as Dean to improve the facilities and administration of the Arboretum. He became the editor of the *Arboretum Bulletin* upon his retirement as Dean in 1965 and gave years of dedicated service until illness forced him to reduce his activity to become Editor Emeritus. An additional service he provided to the College he served so well, was to take over the task of finishing the history of the College of Forest Resources after the untimely death of President Emeritus Henry Schmitz. With the help of the Arboretum Foundation and Mrs. Schmitz this history was published in 1973 as a book entitled "The Long Road Travelled."

STANLEY P. GESSEL
Associate Dean
College of Forest Resources
University of Washington
October 22, 1980

Gordon D. Marckworth, a Note of Appreciation

Dean Marckworth's association with the Arboretum was long and effective. At the time of my appointment to the Arboretum staff in September, 1946, he was chairman of the controlling Arboretum Board, which then met monthly in the old Faculty Club on the University campus, later in his room in the College of Forestry. Members of the Board included representatives from the College, the School of Pharmacy, the Departments of Botany and of Buildings and Grounds, and of the Arboretum Foundation. The Board received regular reports on progress in new plantings and other details and on planning for the future. In addition they discussed and attempted to solve problems larger than the Director was able to handle, such as matters concerning property, boundaries and relationships with the city and neighboring land owners. In all these ways, as well as between such meetings, the Dean was always available for consultation and wise advice. The Arboretum in that period of its development — which was often difficult, especially in respect to land problems — owes much to the strength of his guiding hand and influence in other quarters.

Mrs. Mulligan and I well remember that the first person to greet us on our arrival in Seattle by train from Chicago on October 21, 1946 was Dean Gordon Marckworth, a most unexpected and welcome sight at eight o'clock in the morning on a station platform, but typical, as we later discovered, of this quiet man of great human qualities. We miss him.

BRIAN O. MULLIGAN
Director Emeritus
University of Washington Arboretum

Book Reviews

IRISH GARDENING AND HORTICULTURE, edited by E.C. Nelson and A. Brady. Royal Horticultural Society of Ireland, Ballsbridge, County Dublin, 1979. Large quarto pages 249, illustrated. Price six pounds (hard cover edition; also available in paperback).

The raison d'etre for this book was to celebrate the 150th anniversary of the founding of the Royal Horticultural Society of Ireland, in May 1830, as a society of amateurs; however, it had been originally formed by professional gardeners in 1816 "to protect and promote the science of gardening in Ireland." It was granted royal recognition by Queen Victoria in 1838, one year after her accession to the throne. This work aims at giving a general picture of horticulture in Ireland from the earliest known gardens of the monasteries in the 14th century up to the present time. The Stanley Smith Horticultural Trust, the Ireland Fund, a number of companies and many private individuals have contributed toward its production costs.

As the president of the Society says in his foreword, the book ". . . examines other aspects of horticulture in Ireland, such as the wealth of plants from all over the world which flourish here, and the people who collected or introduced them. It recounts the history of the Society, and of gardening in Ireland, as well as recalling the Irish men and women who have distinguished themselves in horticulture . . ."

Seventeen different authors have each contributed a chapter to this most informative compilation, which is arranged in five sections: The Natural and Cultural Background; Historical Background; Plants and Animals in Irish Gardens; Commercial Horticulture and Arboriculture; The Future. Relevant illustrations, in both color and monochrome, as well as a bibliography, are included in each section.

In the first section, the chapter on the physical environment of Ireland, by Mary Davies of the Royal Irish Academy, Dublin, sets the scene by describing the geographical features, soils and climate of the island. This is followed by Dr. Nelson's thorough study of the native flora, its origins and composition. In the second section, Sheila Pim, librarian for the Society, contributes some twenty pages on the history of gardening in Ireland; this is followed by a complete history of the Society of J.A. Robins, extracted from its records and minutes.

In the third and most interesting section from the plant lover's viewpoint, plant introductions from (a) North America, (b) the Himalayas and the Far East and (c) the Southern Hemisphere are reviewed by Mr. Aidan Brady, by the late Earl of Rosse and by Dr. B.D. Morley respectively. In toto, they give us a comprehensive picture of the enormous range of plants, chiefly woody, from those regions of the temperate world which have been grown in both public and private gardens in Ireland. The National Botanic Garden at Glasnevin, Dublin, founded in the 1790's, is the chief example of the former group.

The first American introductions, by the two Tradescants, father and son, in the first half of the 17th century, were of course from the eastern states, and included the red and sugar maples *(Acer rubrum* and *A. saccharum),* tulip tree *(Liriodendron tulipifera),* black walnut *(Juglans nigra)* and swamp cypress *(Taxodium distichum).* It was not until the early 19th century that introductions came from the western territories, through Thomas Nuttall, David Douglas and Thomas Coulter. The first Asiatic plants were sent from eastern China toward the end of the 18th century, amongst them the *Ginkgo, Ailanthus, Camellia japonica* and *Koelreuteria paniculata.* The tree peony *(Paeonia moutan,* now *suffruticosa)* followed by 1820, and *Rhododendron arboreum* from the Himalayas in 1836. Some plants also arrived from South America before the end of the 18th century, including the lemon-scented verbena *(Aloysia triphylla)* and *Buddleia globosa. Fuchsia magellanica,* now naturalized in some parts of western Ireland, was another early introduction from the continent; *Embothrium, Eucryphia, Azara* and *Escallonia,* which do so well generally in Ireland, followed later.

The chapter by Mr. J. Kelly on Ireland's contributions to ornamental horticulture produces some interesting factual information about the origins of some cultivars well-known in America. Amongst those found in the wild are *Juniperus communis* 'Hornibrookii', *Calluna vulgaris* 'County Wicklow', and *Daboecia cantabrica* 'Praegerae'. From gardens or nurseries came *Hypericum* 'Rowallane' and *Chaenomeles* 'Rowallane', *Pontentilla fruticosa* 'Tangerine', and *Forsythia* X *intermedia* 'Lynwood'. Ireland also has been a premier producer of daffodils, through such breeders as Guy L. Wilson, J.L. Richardson and W.J. Dunlap, and of roses since the mid-19th century, by the Dickson and McGredy firms in Northern Ireland.

Chapter 13, by Eileen McCracken, gives a comprehensive picture of the nursery industry in Ireland, beginning in the 18th century. A two-way trade with Holland has been going on for some 300 years and is still continuing. Commercial horticulture and research is covered by Dr. D.W. Robinson of the Agricultural Institute Research Centre in Dublin. There are now five training centres and six research stations for different purposes in various parts of the country. Horticultural crops are valued at over 40 million pounds in the Republic in 1977, at 12.6 million pounds in Northern Ireland. Vegetables are grown on about 20,000 acres, about half being processed; glasshouses cover nearly 500 acres. So horticulture is no small business. Strawberries and apples are the most important fruit crops.

Chapter 15, "Forestry in Ireland", unfolds a sad story of abuse and decline until the beginning of this century when the Department of Agriculture and the Irish Forestry Society were established and the estate of Avondale bought as a training center. The first professor of forestry in Dublin was Augustine Henry, from 1913 to 1930. In the whole island there are now about a million acres under forest; because of soil and climate, Sitka spruce *(Picea sitchensis)* forms about half the total, while lodgepole pine *(Pinus contorta)* makes up about one-third of the remainder.

"The Natural Vegetation and its Conservation" by A.M. O'Sullivan, forms chapter 16 and supplements Dr. Nelson's discussion on the flora in section I. Because of the rapid expansion of both agriculture and forestry, the author pleads a strong case for setting up a number of small nature reserves, which could be done under the existing Wildlife Act of 1976. Finally, D.A. Shannon of the Dublin County Council considers the problems of "Horticulture in a Changing Environment" and emphasizes the need for many more trained horticulturists, with horticultural programs offered at all levels in the schools.

The work concludes with two indexes, one for plant names which contains a regrettable number of spelling errors, mostly repeated from the text *(Stillea* for *Stellera* is one of the most unfortunate), and a general index of persons, places and subjects. A useful map, drawn by Mary Davies, showing the location of existing as well as extinct gardens, forms the endpapers. The quality and reproduction of the monochrome illustrations vary considerably and often lack contrast or depth, but the selection and placement are commendable. The eight pages in color, from photographs taken mainly by Dr. Nelson, are generally of good quality and typical in color reproduction for the plants shown, but the smaller prints measuring only 4.5 by 6.0 cm in size, or even as small as 2.5 by 4.0 cm, might well have been omitted; they do not do justice to their subjects. A surprising error occurs on page 133, where Professor C.S. Sargent is said to have been Director of the Arnold Arboretum from 1900 to 1911; his actual tenure in this office was from 1873 until his death in 1927!

This work of reference gives a broad view of Irish horticulture, past and present, as well as of the native flora. It will be valuable not only for libraries, but also for those persons who have had or intend to have direct contacts with Irish horticulturists, institutions or gardens mentioned. *BRIAN O. MULLIGAN*

THE AUDUBON SOCIETY FIELD GUIDE TO NORTH AMERICAN TREES (WESTERN REGION), by Elbert L. Little. Alfred A. Knopf, New York, 1980. 640 pages, illustrations, maps. Price $9.95.

This authoritative, attractive and compact book will certainly appeal to many individuals interested in tree identification. It includes species found from the Pacific Coast to the Rocky Mountain and central Texas areas and is a companion volume to a similar book on trees of eastern North America, also by Elbert Little who, until his recent retirement, was Chief Dendrologist of the US Forest Service.

Following the usual introductory material, this volume is organized in three sections. Section One includes numerous fine photographic illustrations in natural color, coordinated with keys related to principal characteristics (foliage, flowers, fruits/cones) of various trees. Section Two describes 312 species arranged within 50 families, including notes of special interests, habitat and small, range maps of native western species. Common trees indigenous to other parts of North America, as well as more common introduced species from foreign lands often planted in the West, are also included in this section. Section Three includes the glossary, picture credits and index.

Considering the experience and recognized authority of the author and the considerable time and effort that obviously went into the publication of this book, one hesitates to venture anything but enthusiastic opinion. Still, use of a book in the field is often accompanied by vagaries of the weather, limited personal time and related difficulties. In consideration of such factors it would seem that the most efficient field identification of trees would be favored by consolidation of their more significant features, including range map, illustrations and brief description, on a single two-page spread. That is difficult to accomplish in a book covering western North America and encompassing over three hundred species. Obviously, it would require considerable condensation of descriptive text for each species, with material of interest not specifically applicable to field identification left to other books designed for more limited regions, or for more comprehensive volumes which could be studied at other times under less difficult conditions.

However, this is a personal reaction; perhaps most others would not find the organization of this book difficult. At any rate, this most recent of several good books on trees of western North America deserves a place in the library of anyone seriously interested in becoming familiar with arboreal vegetation found in the wild or planted in parks, gardens or along streets and highways. *C. FRANK BROCKMAN*

NOHS Sets 1981 Program

The Northwest Ornamental Horticultural Society will sponsor four programs on the fourth Thursdays, January through April, and a fifth in the fall, to be held at the Museum of History and Industry.

January 29, 10:30 AM — "Add Edibles to Your Ornamentals". Speakers: Robert Ticknor, Angelo Pellegrini and Katherine Carey.

February 26, 10:30 AM — "How Natural Soil and Water Conditions Affect Your Garden". Speakers: William Shannon, Robert Zasoski and Charles Pfeiffer.

March 26, 7:30 PM — "Control Your Garden by Pruning". Speaker: Chico Narro. There also will be a filmed demonstration from the Brooklyn Botanical Garden.

April 23, 10:30 AM — "What Plants Do for People". Exhibits and demonstrations by various local plant societies.

October 22, 7:30 PM — " Plant Arithmetic — Multiplying and Dividing", lecture by Harold B. Tukey, Jr.; and Rhododendron Species Foundation, report and demonstration by Kendall W. Gambrill.

Two of these programs will also be presented at the Washington State Historical Society in Tacoma: "Add Edibles to Your Garden", Wednesday, January 28, 1:30 PM; and "Control Your Garden by Pruning", Wednesday, February 18, 7:30 PM.

University of Washington Classes

Spectrum, the quarterly journal for Continuing Education, is sent free to those who have indicated interest in the University of Washington's night courses, adult education classes, concerts and other programs. Those who wish to obtain early notice of such classes and registration forms are urged to place their names on the mailing list by calling 543-2590.

Arboretum Courses

BIRD IDENTIFICATION FOR BEGINNERS. Field course on land birds commonly found in the Arboretum and waterfowl on Lake Washington. Binoculars required. Instructor: Merilyn Hatheway. Limited to 15; Saturdays, January 17-31 and February 7, 21 and 28; 9-11 AM; 6 sessions, $30.

GRAFTING ORNAMENTALS. Techniques for grafting woody plants. Plants and materials furnished. Instructor: Richard van Klaveren, Arboretum propagator. Limited to 15; Saturdays, February 7 and 21; 9:30 AM-12 Noon; 2 sessions, $25.

WINTER IDENTIFICATION OF NATIVE TREES AND SHRUBS. Field class covering 55 species of trees and shrubs native to western Washington, with emphasis on distinctive identifying characteristics. Instructor: Carla Culver. Limited to 20; Saturdays, February 21-March 21; 10 AM-12 Noon; 5 sessions, $25.

PRUNING ORNAMENTALS. Outdoor demonstration class on techniques of pruning ornamental trees and shrubs. Instructor: Chico Narro. Limited to 20; Saturdays, March 14 and 21; 10 AM-12 Noon; 2 sessions, $15.

The Arboretum is open to the public for education and recreation, and classes are offered through the College of Forest Resources as a public service. Be sure to wear warm clothing and waterproof footgear for all courses that meet outdoors. Pre-registration is required for all courses; classes fill rapidly so early registration is recommended. For more information call 545-1373.

Continuing Education

SCIENTIFIC DRAWING. For everyone interested in learning to illustrate with scientific precision, clarity and esthetic appeal, for personal or professional use. Students will learn a variety of lines and shading techniques in black-and-white and color. Instruction includes accuracy of measurement, scale and perspective. You may select your own subject matter and work from specimens or models, microscope, lifesize or reductions (bring microscope if you need one). Instructor: Phyllis Wood, scientific illustrator, Health Sciences Illustration. Mondays, January 12-March 23 (holiday February 16); 7-10 PM; 10 sessions, $58; parking $5.50.

WEATHER AND THE ATMOSPHERE. This course covers a wide range of atmospheric phenomena to help you understand the weather. Meteorological instruments will be demonstrated. Useful to everyone who spends time outdoors or wants to read the sky. No scientific background necessary. Instructor: Kristina Katsaros, Research Associate Professor, Atmospheric Sciences. Wednesdays, January 14 -March 4; 7:30-9:30 PM; 8 sessions, $40; parking $4.40.

WINTER BIRDS OF SAN JUAN ISLAND. There may still be time to register for this weekend on San Juan Island, January 16-18. Call 543-2590 for information.

SCIENCE CLASSES FOR FIRST THROUGH SIXTH GRADERS. In each class, children will experiment with many topics and apply basic processes of predicting, reporting, and drawing conclusions from their observations. Materials included in course fee. For new and returning students. Sections are divided according to grade level. Saturdays, January 10-March 21 (holiday February 14); 10 sessions, $38.

WHALES AND THEIR WAYS. This one-day program will afford you the opportunity to learn the latest about the interesting world of whales, particularly those species found in Washington waters. Topics will include: *Whales and Their Way of Life: An Introduction; How Whales Have Adapted to the Sea; The Gray Whale;* and *A History of Whaling and the Future of Whales.* Saturday, March 6; 9AM-4PM; $22 ($15 for students with I.D.); refunds until February 26.

EXPLORATION AND EXPLOITATION OF SPACE. Exploration of space, one of humanity's oldest and most fanciful dreams, is being realized within our lifetimes. In this series, highlights of the first two decades of this adventure will be discussed. Lectures include *Exploration of the Planets, Saturn: Voyager I Encounter (by Dr. Torrence Johnson of NASA's Jet Propulsion Laboratory),* and *Exploitation of Space.* Instructor: Donald E. Brownlee, Associate Professor, Astronomy. Tuesday, February 24 and Thursday, February 26, 7:30-9:30 PM, and Saturday, February 28, 9:30 AM-12 Noon; $22 (students $12); no refunds after February 17.

Burke Museum Courses

The Burke Memorial Washington State Museum at the University of Washington is offering a lecture series on the natural history of birds, taught by Dr. Dennis Paulson, who has been teaching similar courses at Discovery Park for the past five years. The series will cover many topics relating to the biology of birds, including adaptations for feeding and breeding, social and anti-social behavior, migration and coloration — and students are encouraged to generate their own questions. Two-hour lectures will be illustrated by Dr. Paulson's extensive slide collection. Three field trips are planned: half days at the Montlake Fill and Discovery Park, and a full day at the Skagit Flats and March Point. The six-week series will be offered January 15 to February 19 (lecture day and time yet to be set) at the Museum, with field trips on the weekends of January 17-18, January 31-February 1, and February 14-15. Cost of the class will be $40. Interested people should call 543-5884 to register and for more information.

A second course, on bird identification, will be taught by Dr. Dennis Paulson in the spring. For information please call 543-5884.

Announcements from the Unit Council

The Unit Council has donated $25,000 from the proceeds of the 1980 Plant Sale to be used by the Curator of Plant Collections at his discretion.

The Tenth Annual Bulb Sale was a tremendous success thanks to the efforts of Chairmen, Jeanne Gardiner and Jane Rogers, plus countless volunteers. The net profit was $9267.02.

The Mercer Island Arboretum Units are sponsoring a program on *Flower Arrangements and Table Settings* by Helena Mairs (Mrs. Henry) on February 12, 1981 at 1 PM, United Church of Christ, 4545 Island Crest Way, Mercer Island. Admission is $2.00 beforehand or at the door. Coffee, tea and cookies will be served. Chairman, Mrs. Fred (Deanna) Meine, 232-8708.

The *Fourth Annual Horticultural Exhibit,* under the chairmanship of Suzanne Wilson, will be held at the Northgate Mall, March 28, 1981 from 9:30 AM to 6 PM and March 29, 1981 from 11 AM to 5 PM. This year, in addition to beautiful mixed flower displays, we are going to offer educational exhibits. All Units are welcome to participate.

Molly Wolfe, Education Chairman, reports full enrollment in all previously announced *Classes and Workshops* for 1980-81.

Ruth Vorobik, Chairman, *Japanese Garden Training,* announces that the Japanese Garden Guides will hold six training sessions this spring in the Japanese Garden and other places. Topics will be:

- How the Japanese Garden in the Washington Park Arboretum came to be.
- Gardens in Japan and how they developed — Japanese gardens in America.
- Trees and shrubs in the Garden and how it is maintained.
- Guiding: problems and pleasures.

Time: 11 AM-12 Noon Wednesdays, March 18-April 22. $15. Bring brown bag lunches. There will be a discussion period in the afternoon for those who can stay.

If you are interested please leave your name and phone number at the Arboretum Office (543-8800) with Jan Pirzio-Biroli (Jan P-B), Volunteer Coordinator. *MOLLY WOLFE*

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THE ARBORETUM FOUNDATION

STATEMENT OF CASH RECEIPTS, DISBURSEMENTS
AND CHANGES IN CASH BALANCES

	Year ended April 30, 1980					Year ended April 30, 1979
	Unrestricted	Restricted	Building Fund	Endowment Trust Fund (Note 4)	Total all funds	Total all funds
Receipts:						
Dues	$ 37,071				$ 37,071	$ 35,519
Donations	4,933				4,933	4,633
Japanese Tea House (Note 5)		$20,610			20,610	
Unit Council-						
Plant and bulb sales	71,233				71,233	65,839
Other	1,303				1,303	1,342
Interest on savings and investments	48,645	2,832	$ 19,331		70,808	52,994
Income from investment trust				$1,717	1,717	1,205
Advertising and miscellaneous	5,650	1,385	968		8,003	5,817
Repayment of advances to University of Washington Press (Note 2)						22,000
	168,835	24,827	20,299	1,717	215,678	189,349
Disbursements:						
Salaries and wages	21,050				21,050	18,860
Payroll taxes	2,034				2,034	1,873
Bulletin and publications	26,242				26,242	24,344
Publicity	3,142				3,142	3,235
Other operating expenses	10,656	3,465		400	14,521	11,397
Unit Council expenses-						
Plant and bulb sale costs and expense	39,091				39,091	38,600
Utilities, supplies and postage	4,401				4,401	8,355
Donations to University of Washington Arboretum	23,754				23,754	19,320
Donations to Japanese Garden						12,453
Donations to Memorial Area						8,180
	130,370	3,465		400	134,235	146,617
Excess of receipts over disbursements	38,465	21,362	20,299	1,317	81,443	42,732
Transfer of Endowment Fund income	1,393			(1,393)		
Cash balance, beginning of year	430,070	5,367	166,920	315	602,672	559,940
Cash balance (including short-term investments), end of year (Note 1)	$469,928	$26,729	$187,219	$ 239	$684,115	$602,672

THE ARBORETUM FOUNDATION

NOTES TO STATEMENT OF CASH RECEIPTS, DISBURSEMENTS
AND CHANGES IN CASH BALANCES

YEARS ENDED APRIL 30, 1980 AND 1979

The Arboretum Foundation was formed on June 11, 1935 to help promote and assist the development and maintenance of the University of Washington Arboretum, Botanical Garden and Herbarium.

NOTE 1- CASH BALANCES:

The cash balances, including short-term investments, at April 30, 1980 and 1979 were as follows:

Deposited with	April 30 1980	April 30 1979
Commercial accounts:		
Peoples National Bank	$ 12,805	$ 5,151
Rainier National Bank	243	250
Savings accounts:		
Washington Mutual Savings Bank		10,835
Prudential Mutual Savings Bank		8,757
Banker's acceptances, Rainier National Bank		487,656
U.S. Treasury bills, at cost which approximates market	560,959	
Merrill Lynch ready asset accounts (including $25,551 of unit council funds at April 30, 1980)	109,843	89,683
Seattle-First National Bank trust account	239	315
Cash on hand	25	25
	$684,115	$602,672

NOTE 2- ADVANCES:

In prior years, the Arboretum Foundation advanced funds to the University of Washington Press to assist in financing publication of books which are beneficial to the Foundation's interests. During the year ended April 30, 1977, the Foundation advanced $22,000. The advance was repaid during the fiscal year ended April 30, 1979. No additional advances have been made.

NOTE 3- RETIREMENT FUND:

During the year ended April 30, 1978, the Foundation invested approximately $10,100 in an annuity contract to provide retirement benefits for Mrs. Marilyn Holm, the former executive secretary. The annuity contract is for ten years beginning in 1987 with the Arboretum Foundation named as beneficiary of the balance if Mrs. Holm is not then living. The market value of the contract at April 30, 1980 and 1979 was approximately $11,900 and $11,000, respectively.

NOTE 4- ENDOWMENT TRUST FUND:

On March 10, 1944, a trust agreement was established between Seattle-First National Bank, as trustee, and the Arboretum Foundation for funds bequested to the Foundation. Pursuant to the trust agreement, the principal of the Endowment Trust Fund may not be disbursed prior to March 10, 1994 and at that time is to be disbursed to the University of Washington for use in its Arboretum. The trust agreement may be extended by mutual consent of the parties. The principal is invested with Seattle-First National Bank in common stock and bond funds. The balance in the principal account at cost was $16,285 with market-values of approximately $15,400 and $16,600 at April 30, 1980 and 1979, respectively.

NOTE 5- COMMITMENTS:

The Foundation Board of Directors has designated $75,000 of unrestricted funds be set aside to be paid to the University of Washington over a five year period for partial support of the salary and office of the Director of Arboretum programs.

The Foundation plans to construct a new Japanese Tea House during the fiscal year ending April 30, 1981. The cost of such a facility is expected to be approximately $120,000, and is being financed by a special fund drive. During the fiscal year ended April 30, 1980 the Foundation received $20,610 in donations from the fund drive. These receipts are reflected in the restricted fund in the accompanying statement of cash receipts, disbursements and changes in cash balances.

New Members of the Arboretum Foundation

We are pleased to welcome the following new members (June 1, 1980 through September 30, 1980): *Family*—Regina Martin, Mr. & Mrs. Clint Smith, Soderland/Hardisty Family, Mr. & Mrs. Raleigh Taylor, Mrs. Rebecca Varon. *Sustaining*—Maureen E. Conners, Mrs. Gerald Frey. *Annual*—Drs. George & Joanne Armstrong, Anne Marie Bartley, Kenneth Beier, Charles Berry, Mrs. Anne Bills, Blue Jeans Garden Club, Bremerton Garden Club, Mrs. Barbara Brodnick, Mrs. Susan Buckles, Mrs. Shirley Burtt, Fir Butler, Pamela Kay Callahan, Louise Clark, Maureen E. Conners, Mrs. J. Lawson Cook, Marija Cruz, Dan Daffron, George W. Douglas, Gretchen Echols, Mrs. Karl Ellerbeck, Barbara Ferrin, Mrs. Martha A. French, Mrs. Gerald Frey, Mrs. Diane Gallup, Mrs. Roger Gotteland, Mrs. Linda Grace, J. Greenwell, Mrs. George Grimes, John Hagman, Linda Henry, Margaret Huntsberger, Kathleen E. Jermann, Dr. Annie May Karrer, Mrs. Donald Kinkead, Howard G. Labo, Joyce Lindsay, Mrs. Joe L. Long, Jr., John Dawson Long, John Lycette, Jr., Mrs. William Mackay, Regina Martin, Scott Mayer, Mrs. Lois Milligan, Mrs. Cathy Morgan, Orcas Island Garden Club, Arthur J. O'Sullivan, Mrs. James W. Parker, Patricia Rasmussen, Samuel C. Roskin, Mrs. Jeanette Sampson, Mrs. Roger Sampson, Mrs. Paul Sather, Hans J. Sauter, Mrs. Doris Schack, Mrs. Taeko Searth, Jean Seeley, L.F. Semler, Mrs. James Shenfield, Mr. & Mrs. Clint Smith, Mrs. Gretta Stimson, Mrs. Susan Stone, Mrs. John F. Sullivan, Jr., Mr. & Mrs. Raleigh Taylor, University of Chicago Library, Diane Lea Unmacht, Mrs. Rebecca Varon, Harry R. Venables, Miss Roberta Wightman, Mrs. Harold Williams, Mrs. June Willstadter, Mrs. Marylynne Zwiebel.

CALENDAR OF EVENTS

Arboretum Foundation:		Regularly Scheduled:	
Board of Directors	March 12	Greenhouse Day	Every Tuesday
Executive Committee	January 14	The Mae Granston Rhododendron Study Group	1st Monday
	February 11	Herbarium Committee	1st Friday
	April 8	Northwest Natives Study Group	3rd Monday
Unit Council:		Rock Garden Study Group	3rd Wednesday
Unit Council Meeting	March 19	Arboretum Explorers	4th Wednesday
Governing Board	January 8	For additional walks in spring call 325-4510	
	February 5		
	March 5		
	April 16		

CONSERVATORY IN VOLUNTEER PARK, SECOND SUNDAYS, 1-4 PM (see page 6 for scheduled features).

THE WILDFLOWERS OF THE COLUMBIA RIVER GORGE, lecture sponsored by the Seattle Garden Club, January 15 (see page 6 for details).

NOHS LECTURE SERIES, 3rd Thursday, January through April (see page 39 for programs).

ARBORETUM FOUNDATION UNIT COUNCIL
HORTICULTURAL EXHIBIT AT THE NORTHGATE MALL
Saturday, March 28, 9:30 AM - 6 PM and Sunday, March 29, 11 AM - 5 PM
(see page 41 for details)

ARBORETUM FOUNDATION PLANT SALE
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Photo: Richard van Klaveren

Visit the Arboretum in Late Winter and Early Spring *and* Tour Holland Next Summer with Richard van Klaveren

Windmill in Holland.

The College of Forest Resources and the Arboretum are sponsoring a tour of Holland next July. Mr. van Klaveren, tour leader, is a native of Holland who has worked and taught at the Arboretum as plant propagator for twenty years.

The tour will concentrate on gardens and nurseries in Holland; the itinerary will include Keukenhof, the Aalsmeer flower auction, the large nurseries and Arboriculture Research Station of Boskoop, the Arboretum landbouwhogeschool at Wageningen, and a trip over the German border to the famous *Rhododendron* garden at Bremen. The cities of Delft, The Hague, Amsterdam and Rotterdam will be included, with excursions to major places of more general interest such as the Rijksmuseum, Deltaplan Zeeland (where land is reclaimed from the Zuider Zee) and the miniature city of Madurodam. Travel within Holland will be by chartered coach with driver and courier; the emphasis will be on day trips from two or three central points, since distances in Holland are short.

The tour will last approximately two weeks, and arrangements for travel to and from Europe will be designed in such a way that individuals can easily extend the trip to visit other countries after the conclusion of the tour.

If you would like to receive additional information about the tour, contact Ruth Jacobson at the College of Forest Resources Continuing Education office, 545-1373.

Join the Explorer's Walks meeting at 10 AM the fourth Wednesday of each month in the Administration Building parking lot: January 28, February 25, March 25, and April 22. Call 325-4510 for information about special walks in spring.